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CONTENTS:

	PAGE
The Electric Lighting of Barnet	229
A Retrospect	230
A Universal Telegraph Instrument (*illustrated*)	232
Trials of Motors for Electric Lighting	233
Wright and Moore's Type Printing Telegraph (*illustrated*)	233
A Synthetic Study of Dynamo Machines (*continued*) (*illus.*)	237
Electric Lighting in India	239
Memorial to G. S. Ohm	240
Reviews :—Les Compteurs d'Energie Electrique	240
The Voltaic Accumulator	241
Notes	242
City Notes, &c. :—The Submarine Telegraph Company ...	246
Telegraph Construction and Maintenance Company ...	247
Electric Date and Time Stamp Company	247
Traffic Receipts	247
City Electric Lighting	247
Barnet Electric Lighting	251
Proceedings of Societies :—Institution of Civil Engineers ...	253
Abstracts of Published Specifications	255
Correspondence :—Barnet Lighting	255
Comparisons	255
The St. Katherine Lighthouse	256
Harrow Lighting	256
The Telephone in Tunbridge Wells	256

THE ELECTRIC LIGHTING OF BARNET.

THE electric lighting of Barnet once more calls for particular notice. And not by reason of its unqualified success, unfortunately. We reprint this week, from the *Barnet Press*, a report of a recent meeting of the Barnet Local Board which is more interesting and throws more light upon the history and peculiarities of the Barnet installation than anything before published. We learn several things from it, moreover, regarding photometry and electric lights in general, which we did not before suspect. For instance, the report of the expert, or rather of the expert's assistant (who perhaps does not claim to be an expert), states that the lights were on two certain nights "all that could be desired," and yet shows that whereas all should have been of 32 C.P., some were only of 14 C.P.! Whatever Mr. Probert may think, the Barnet Local Board and the people of the town generally can scarcely regard such a state of things as "all that could be desired." Then we further learn that the proper way to test the lighting power of lamps is to ascertain what, under the very best possible conditions, they *might* be capable of doing, and write that down as their real photometrical value upon a certain defined occasion, when they are not in a condition to show at their best. Whether this is the proper way of making photometric tests or not, it was not what the Barnet Board wanted; their reason for calling in an expert was to ascertain precisely what amount of light they were getting in their streets, and not what candle-power the lamps would give if they had cleaner globes, or globes in which the absorption was less. It will scarcely need our aid to make clear to the Barnet Local Board that the figures which they should regard as the correct ones, and as supplying the data for which they asked, are those first given in Mr. Probert's report, and not those within parentheses, which include the added 20 per cent. The contractor was expected to erect lamps which would give out 32 C.P. upon the streets, and if he used globes which absorbed 20 per cent. of the light, he should have seen to it that sufficient current was generated to make up for this absorption. These features of the report of Mr. Probert we cannot describe as anything less than extraordinary; indeed, we do not know where to look for an explanation of them, they seem so utterly opposed to common sense. If there is an explanation, we should be glad to learn what it is.

Coming to the discussion which took place upon the reports of Messrs. Preece and Probert, it seems to us that Mr. James was almost the only member of the board who had any clear conception of what he was talking about. He had gone to the trouble of making observations of a general character for himself; that is to say, he noted the general condition of the lighting every night, whether it was good or bad, how many lights were out and how long they remained extinguished. This report of Mr. James's does not harmonise very closely with Mr. Probert's; indeed, on the nights of Mr. Probert's visits, when he said the lights were "all that could be desired," Mr. James's record showed —"February 2nd.—Lights very poor over whole of district; 4th, ditto." Perhaps Mr. Probert, when coming to the conclusion that the lights were "all that could be desired," mentally added to the actual illumination the 20 per cent. which he assumed to be absorbed in the glass globes, intending his description to apply to what would have been the case if a great deal more light had been given. But it is vain to speculate upon the attitude, mental or otherwise, of a man who observes and records what ought to be instead of what is.

Our readers will not fail to detect several very amusing points in the discussion. Mr. Schmidt evidently regards himself as an authority upon electric lamps; witness his sage remark that "All electric lamps are experimental, but there is now a new lamp in the market surpassing all others." Not only is he an authority upon lamps, but he is a judge of men. The electric light failed at Leamington, certainly; but they had not at Leamington such an engineer and electrician as "the one at Barnet"! Well, well, comparisons are proverbially odious, and we are quite sure Messrs. Chamberlain and Hookham do not *wish* to be put in comparison with Mr. H. F. Joel. We are unaware of any great public work which he has carried through with such a vast amount of credit as to inspire that beautiful confidence and admiration which was displayed by the wise Mr. Schmidt. One other assertion by Mr. Schmidt cannot be dismissed without remark. He made what to us is the astounding statement that the electric light has been more successful in Barnet than anywhere else! All we can say to this is, if that be the case, poor electric light! Mr. Schmidt, you really should learn something about your subject before you venture again to become so oracular.

Now we come to a more serious subject. The contractors certainly based their estimate of returns upon a single plant, and now that they are required to nearly double their original outlay, what will become of their anticipated profits? This will be a bitter disappointment to them, no doubt; but have they not themselves alone to blame? They knew, or should have known, that to provide effectually against breakdown, a duplicate plant was necessary. If they chose to calculate upon a certain profit as the result of keeping the plant at a minimum instead of providing a reserve, they should not be surprised, now that accidents and breakdowns have been so frequent, that they are called upon to duplicate. We see that Mr. Schmidt, who appears to have constituted himself champion of and spokesman for Mr. Joel, announced that a duplicate plant had been ordered. We hope it will soon be in place, and that no further such miserable *contretemps* as those we have had hitherto to chronicle will occur. We are quite convinced that, even now, after a series of ghastly failures, the electric lighting of Barnet might be carried out and improved into a success, provided competent advice is sought. We suggest to the contractors the strong necessity which exists for their seeking such aid. One point which among others they might then learn is that incandescent lamps in series cannot be expected to give equal luminosities unless each filament is of precisely the same resistance and diameter, because the same current passes through all, whether thick or thin. It is, indeed, a question whether it would not be better to employ some other method of arrangement. But, as we say, advice of a competent order, faithfully acted upon, will enable the Barnet installation to emerge after all from its time of trial and tribulation with credit and success.

We see that the *Barnet Press* accuses us of suggesting that the expert "betrayed the confidence of the board." With due respect, we suggested nothing of the kind. If the *Press* will take the trouble to look up, in its issue of February 9th, the report upon which our note of February 15th was written, it will see that it is therein stated by Mr. James that the contractor was aware that the photometric measurements were to be taken at a given time. Mr. James questioned the value of a report made under such circumstances, and we endorsed his remarks. We certainly made no imputation against the "expert" other than that he had acted very injudiciously, in which opinion, so far as we can gather, the *Barnet Press* joins. Our contemporary quite misunderstood our reference to the matter.

A RETROSPECT.

UNTIL we had read the recently published "Life of Sir William Siemens" we should have thought it impossible for such a life to be written without mention being made of the name of Fleeming Jenkin, and his works receiving acknowledgment.

Both Siemens and Jenkin were electrical engineers in the true sense of the term, and as such became eminent men. In what may now be called the early days of submarine telegraphy they were connected with and assisted in the manufacturing and laying of the many cables manufactured by Messrs. Newall & Co. This close connection must surely have brought them together to the mutual advantage of themselves and their employer; but be that as it may, all who have studied the war of the electrical units, which was so gallantly fought about 25 years ago, know how prominently both names stand forth in the conflict; antagonistically it is true, for one advocated the British Association unit, or what is known at the present time as the B.A.s., and the other the mercury or Siemens unit, as it was called, a unit no longer used in England.

The very earliest investigators of electrical science soon discovered the difference in the conducting power of what they called conductors, showing also that the insulation of insulators varied according to their thickness, and the importance of this discovery is shown in the fact that it is now suggested to celebrate the centenary of the birth of Prof. Ohm, who in 1827 published his now well proven law, "That the current through a given circuit is inversely proportional to the resistance, and directly proportional to the force producing it."

In 1843 the "Wheatstone bridge" or "balance" was introduced, and eventually gave great facilities to the working of Ohm's law, an ably written account of which is published under the title, "Reports of the Committee on Electrical Standards appointed by the British Association for the Advancement of Science, with a Report to the Royal Society on Units of Electrical Resistance," by Prof. F. Jenkin, F.R.S.

We should imagine that the young electrical engineer of the present day must find it difficult to realise the fact that even so recently as 30 years ago the then electrical engineer had no unit to guide him or resistance coils to assist him, having to take experience for his pilot and prudence for his compass; but even by such means good and useful work was done.

The practicability of submarine telegraphy was considered established, and the manufacture of the cable to be laid between Ireland and Newfoundland was well advanced when Prof. Thomson (now Sir William) called attention to the fact that not only did the specific conductivity of the conductors vary, but that there was a great difference in the specific conductivity of the same metal, as then manufactured; he also clearly proved that the specific conductivity of the copper then being used for the Atlantic cable differed as much as 30 per cent. even in that supplied by the same maker. This was an important and valuable addition to our electrical knowledge, although very annoying to the Atlantic Telegraph Company, who had proceeded too far in the manufacture of their cable to take advantage of this new discovery. It was amusing at times to hear how the veriest tyro who had just taken his first plunge into matters electrical would glibly hold forth upon the importance of a knowledge of the specific conductivity of the various "conductors" and "insulators." Units for standards of resistance sprung up with mushroom-like rapidity, resembling also that fungus in the variation of their size and quality. No wonder, then, that manufacturers became sorely puzzled and perplexed. Some of them had a laudable thirst for electrical knowledge, while others appear to have been imbued with the notion that weight or measure would compensate for specific resistance, and therefore they gave no further thought to the matter. This was the slough in which electricians were floundering when the British Association and the Royal Society came to the rescue, rendering good service by not only producing the recognised, and in England universally adopted, B.A. or Ohm standard for resistance, but also by giving units for other electrical measurements.

We are of opinion that the Royal Society should form a committee of its members to re-determine the unit of resistance, for as it has already done good service in the matter, we should like to see it raise upon the foundation thus laid a standard to be seen by all and disputed by none.

DR. HOPKINSON has been studying the magnetisation of iron at high temperatures. We wonder whose dynamo he used for the experiments?

OUR esteemed contemporary, the *Electrician*, has given up calling a set of important exhibits in the Edison case F.I.B. 1, F.I.B. 2, &c. We thought the alteration in the initials was meant as a kindly compliment to the talents of a very eminent witness, but it must have been only a misprint.

MR. C. P. HARRIS should read the ELECTRICAL REVIEW each week. Were he in the habit of so doing he could not have pleaded ignorance of Mr. Preece's report on the City lighting when discussing the matter at the meeting of the Commission of Sewers the other day. The other two-thirds of the Commission, mentioned by Mr. Harris, might also do well to seek for information in the technical press.

WE have heard that the use of the globes is in some localities considered, together with "deportment," as being necessary to any complete educational currriculum. So far as the question of "deportment" is concerned, the most carping spirit could have no fault to find with our contemporary the *Electrician*; but with regard to geography, our fellow labourer in the cause of science is, it would appear, *pas trop fort*. In the issue of the journal we refer to for February 8th, we notice that the cable between Punta Rassa and Key West is spoken of as the "West Indies and British Guiana cable." We are glad to be in a position to assure our contemporary that Punta Rassa is in the State of Florida, United States of North America, and that Key West, a name derived from the Spanish (Cayo Hueso) (or Bone Cay), is one of the islands forming the Florida Reef, and situated midway between Habana and Punta Rassa.

MR. W. J. CARRUTHERS WAIN, in addressing the shareholders of the Southwark and Deptford Tramways Company on Monday, in referring to the desirability of electric traction, stated that an arrangement had been made with an electrical company to conduct experiments upon their lines, free of cost. The system of Mr. Jarman is that which will probably be employed.

IN a contemporary there appeared last week a report of an important meeting held at Harrow, to receive from Mr. R. E. Crompton a practical proposal for the introduction of electric lighting into that place. A letter, which was also published at the same time, makes it appear, from the writer's point of view, that Mr. Crompton has become a rabid convert to the converter system; but a communication from that gentleman, which we publish in our other columns, places a somewhat different aspect upon the matter.

AMERICANS are far behind in dynamo construction, if Mr. R. S. Dobbie's article on ring armatures in the New York *Electrical World* is to be taken as representative. The writer thinks that the field magnets of continuous current machines should be nearly if not quite saturated while the magnetism in the armature should be considerably short of saturation to avoid heating. He also thinks that it is a useless refinement to make armature plates thinner than $\frac{1}{16}$ of an inch, and that an excessive area of pole surface is objectionable because constructors overrate the resistance of the air space. We take exception to all these statements believing that the armature core should be saturated to a greater degree than the magnets, that the thinner the armature plates are made the better the result and that the larger the area of air space the better, provided the tips of the respective pole pieces do not too closely approach each other. We agree with the statement in our contemporary's editorial that there is some choice in proportion still left to the designer, but we scarcely think that Mr. Dobbie's article will do much towards enabling one to choose.

SPEAKING at the meeting of the Gas Light and Coke Company, Colonel Makins, M.P., the chairman, expressed his confidence that the electric light would not hurt gas companies, and, in evidence of this, he said that the Bond Street district, where the electric light was most used, produced in gas rentals £7,527 in 1885, and £7,836 in 1888. The electric light was a very fine healthy child, but, like other young children, it had all its troubles to come, and would have its difficulties with the Vestries, as gas had had. He thought that the lighting of Hyde Park Corner was the finest in Europe, and that with arc lights or incandescent lights it would not be so good, and the ratepayers would have to pay a good deal more.

A UNIVERSAL TELEGRAPH INSTRUMENT.

SOME improvements have recently been made in the Neale Acoustic Dial used by the Postal Telegraph Department by Mr. H. Pomeroy, superintending engineer, Southern Ireland District, of which we purpose giving a few particulars.

These alterations (see sketches below) have been made so as to constitute what may well be called a universal instrument; it is now available as a single or double current sounder, a single needle, or a Bell instrument, the chief gain of the whole arrangement being the entire absence of any adjustment to be made by the clerk working the instruments on any of these systems.

The improvements consist of:—

1. The reversing of the inducing magnet, M (fig. 4), to allow the dials to be fitted into the old needle galvanometer cases, thus saving the expense of providing new cases.

2. A considerable lengthening of the needle, N (fig. 2), as it was found that the slight angular movement of the short needle rendered the visual signals very obscure, making it difficult to read by sight.

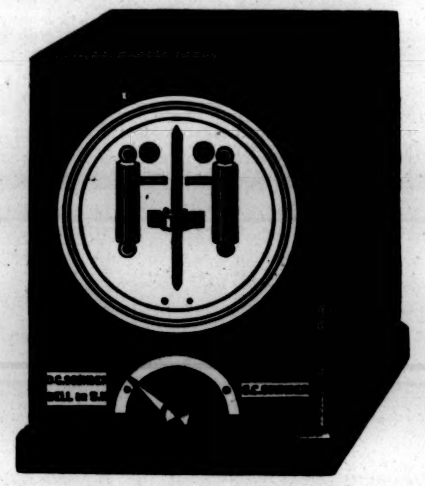


FIG. 1.

3. The replacing of the old adjusting gear by a simple switch (S, figs. 2 and 4), the moving of which brings the needle into its proper position for working, shown by the directions against the pointer in fig. 1.

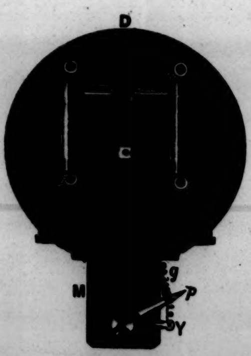


FIG. 2.

Fig. 1 gives a general view of the complete instrument.

Fig. 2 gives a front view, fig. 3 a back view, and fig. 4 a side view of the dial removed from the case. Fig. 5 shows the needle removed from the dial. "D D is the ordinary dial plate to which the two metal tubes, *t* and *t'*, are secured by means of screws passing through flanges at their ends. Fixed to these tubes are metal pins, *e*, *e'*, against which the needle, *n*, strikes. The two tubes are made of different thicknesses of metal, so that they emit different notes.

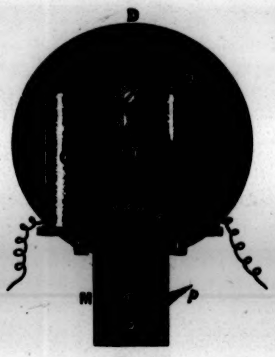


FIG. 3.

The needle is made to move by the electro-magnet, *c*, c_1 (fig. 3), the pole pieces of which, *a* and *b*, project through the dial, as shown in fig. 2.

M (fig. 4) is a permanent magnet, the upper end of which is bent at right angles to the lower. This end, which is forked, passes a short distance through the face of the dial, its prongs being in close proximity to the bottom of the upper half, *n*, of the indicating needle. The back part of *n* (fig. 5) is formed of a broad piece of soft iron (shown by the shaded portion), through which the axle of the needle passes. This portion of the needle is magnetised by the inductive action of the magnet, M, already mentioned. Consequently, its upper part is attracted and repelled by the pole pieces, *a*, *b*, according to the direction of the current, and is thus made to strike against the stop pins, *e*, *e'*.

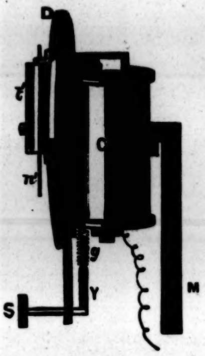


FIG. 4.

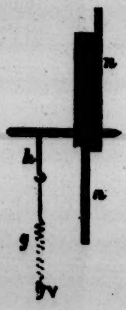


FIG. 5.

The axle of the needle, *n* (fig. 5), is fitted with a small hook, to which a spiral spring, *g*, is attached, the other end of the spring being attached to the elbow, *r* (figs. 2 and 4), of the switch, *s*. The switch is fitted with a milled screw, *s*, and a pointer, *p*; it has only two positions, one shown in figs. 1 and 3, where the needle remains in a vertical position without bias, and the other, as fig. 2, in which the needle is pulled to the left stop, and thus forms the spacing signals for single current sounder working by the action of the spring, *g*.

For bell or single needle signals the needle remains vertical, and strikes either of the stop pins, according to the direction of the current through the instrument, always returning to the centre position when current is off.

For double current sounder working the needle also remains in the centre, without any bias; then when the sending station puts on a spacing current by turning the switch of the key, the needle strikes the left stop pin, immediately going to the right, when the key is depressed, reversing the current, the signals being remarkably loud and clear.

It will be seen that with the same battery power double current working has an advantage over the single current system, as no bias in the needle has to be overcome.

This instrument when used as a sounder replaces the relay, local battery, sounder, and galvanometer at present supplied—an enormous saving in the cost of apparatus at small country offices where the traffic can now be equally as well performed on the single universal instrument.

The absence of any adjustment, too, will be valued by those who are aware of the inability usually displayed by inexperienced telegraph clerks to adjust their apparatus, and trouble will be less likely to arise from loose or broken connections, the total number of terminals, exclusive of key, being reduced to two.

Another gain will be that clerks who are acquainted with one system only, *i.e.*, either needle or Morse sounder codes, if transferred to an office where one of these universal instruments is fixed, can send and receive on either plan, and those anxious to learn both methods can readily do so on the same circuit. In cases of special arrangements, too, it will be unnecessary to have a sounder fixed at an office on a needle circuit, as the instrument will be able to work to any larger office when extended on a sounder circuit.

The universal instrument has been successfully tried on a double current sounder circuit of over 120 miles in length, and on a bell circuit of 35 miles with five instruments on it, signals being read without the slightest difficulty in both instances.

To make the universal set complete, a key for use with the receiving instrument has also been designed which will send single or double current, as well as bell or needle signals, without alteration. A description of this key will shortly appear.

TRIALS OF MOTORS FOR ELECTRIC LIGHTING.

THE following letter from the judges appointed by the Society of Arts accompanied the report referred to in last week's number of the REVIEW:—

3, Princes Street, Westminster, S.W.,
25th January, 1889.

Dear Sir,—We have pleasure in enclosing herewith our report, as the judges appointed by your society, upon the trials of motors for electric lighting made by us for the Society of Arts in September last. With the report we also enclose the various drawings, diagrams, and copies of indicator diagrams which are referred to in it.

We have to point out that the four engines which we have tested belong to three several classes under the conditions of the competition.

The Paxman engine was the only steam engine, and the only engine in Class A. Its performance as to economy of fuel was in every way excellent, its workmanship was also first class. Under paragraph 8*a* of the conditions it left something to be desired, for during the speed trials the governor hunted considerably. We see no reason to suppose that this defect could not be easily remedied. The principal particulars of the experiments on the Paxman engine are given in Table XI.

The Atkinson engine falls into the first group (under 10 H.P.) of Class B, and does not, therefore, compete directly with either of the other two gas engines. The particulars of its trials are given in Table I., from which it will be seen that it attained a very high economy in gas consumption, and in other respects worked very satisfactorily.

The other two gas engines, namely the Crossley and Griffin, are both in the second group (over 10 H.P.) of Class B, and therefore are in direct competition. It will be seen from Tables V. and VIII. that the Otto engine running upon the brake (without the countershaft) uses much less gas per brake H.P. than the Griffin.

The Otto engine, however, as submitted to us for electric lighting, used so much power in connection with driving its countershaft, that the consumption of gas *per H.P. available for electric lighting* was practically the same in both engines. The governing of the Griffin engine was distinctly better than that of the Crossley. The consumption of cylinder lubricant was considerably more in the Griffin than in the Crossley. In both cases the engines ran quite cool during all their trials.

Each of the three gas engines was tended by one man only during its trials.

We have conferred with your committee on motor trials as to this report and our award, and after consultation with the committee, we beg to make the following recommendation to your council:—

As the Paxman and Atkinson engines are each the sole representatives of a class, and have each given exceptionally good results, we recommend that a gold medal be awarded to each.

As regards the other two engines, one (the Crossley) has the advantage in respect to economy of gas and of lubricant, and the other (the Griffin) in respect to regularity of speed. In this competition both these points are of the first importance, and considering the general excellence of both engines in other respects, we recommend that a gold medal should be awarded to each.

We remain, dear Sir,
Yours faithfully,
(Signed) JOHN HOPKINSON.
(Signed) BEAUCHAMP TOWER.
(Signed) ALEXANDER B. W. KENNEDY.

H. Trueman Wood, Esq.,
Secretary of the Society of Arts,
John Street, Adelphi.

WRIGHT AND MOORE'S TYPE PRINTING TELEGRAPH.

THE object of this apparatus is to enable the printed records, which in the ordinary form of printer are made on a continuous tape or band, to be effected on a sheet of any desired width, after the manner of the ordinary type writer. The advantages of such an arrangement are so obvious that they do not require discussion. Messrs. Wright and Moore's invention is not the first of its kind; as far as we can learn, three other printing machines of the same type have been patented—two in America and one in England—the latter by Mr. Higgins, of the Exchange Telegraph Company. The American machines are those of Messrs. Anders, of Boston, and Van Hoevenburg, of New York. Neither

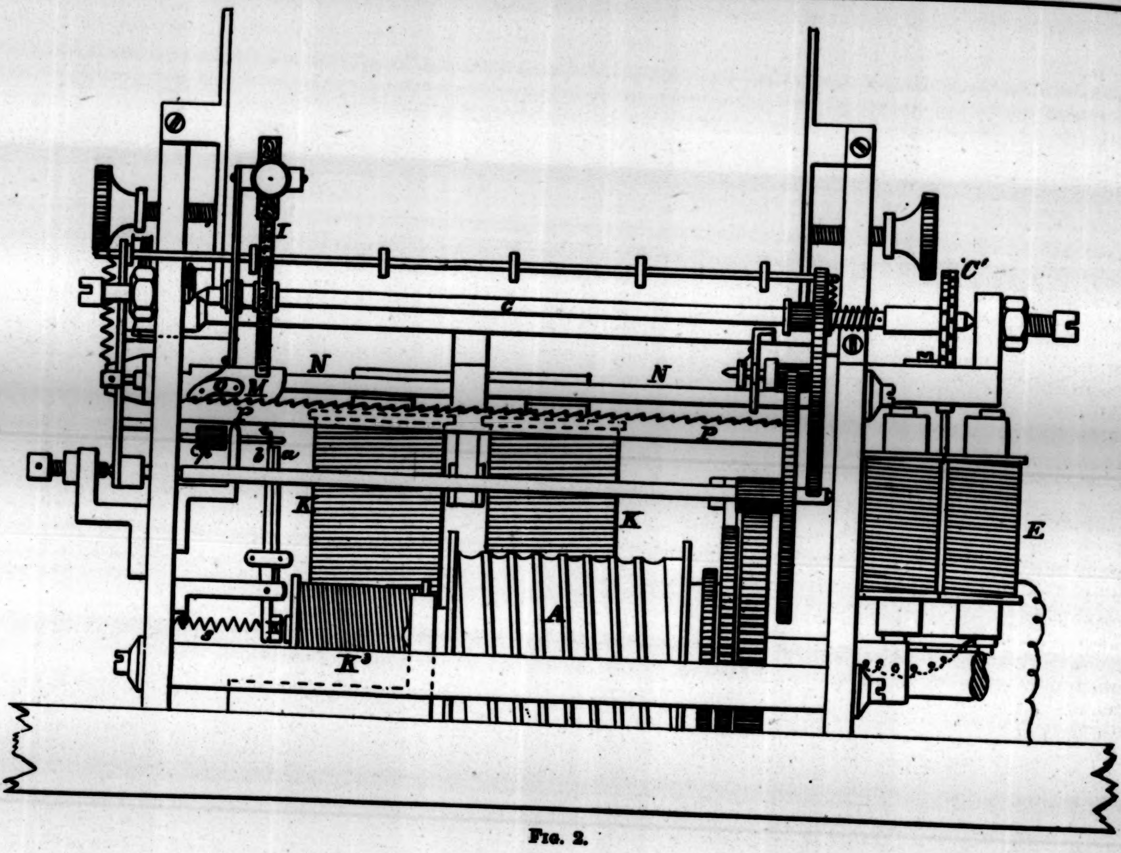


FIG. 2.

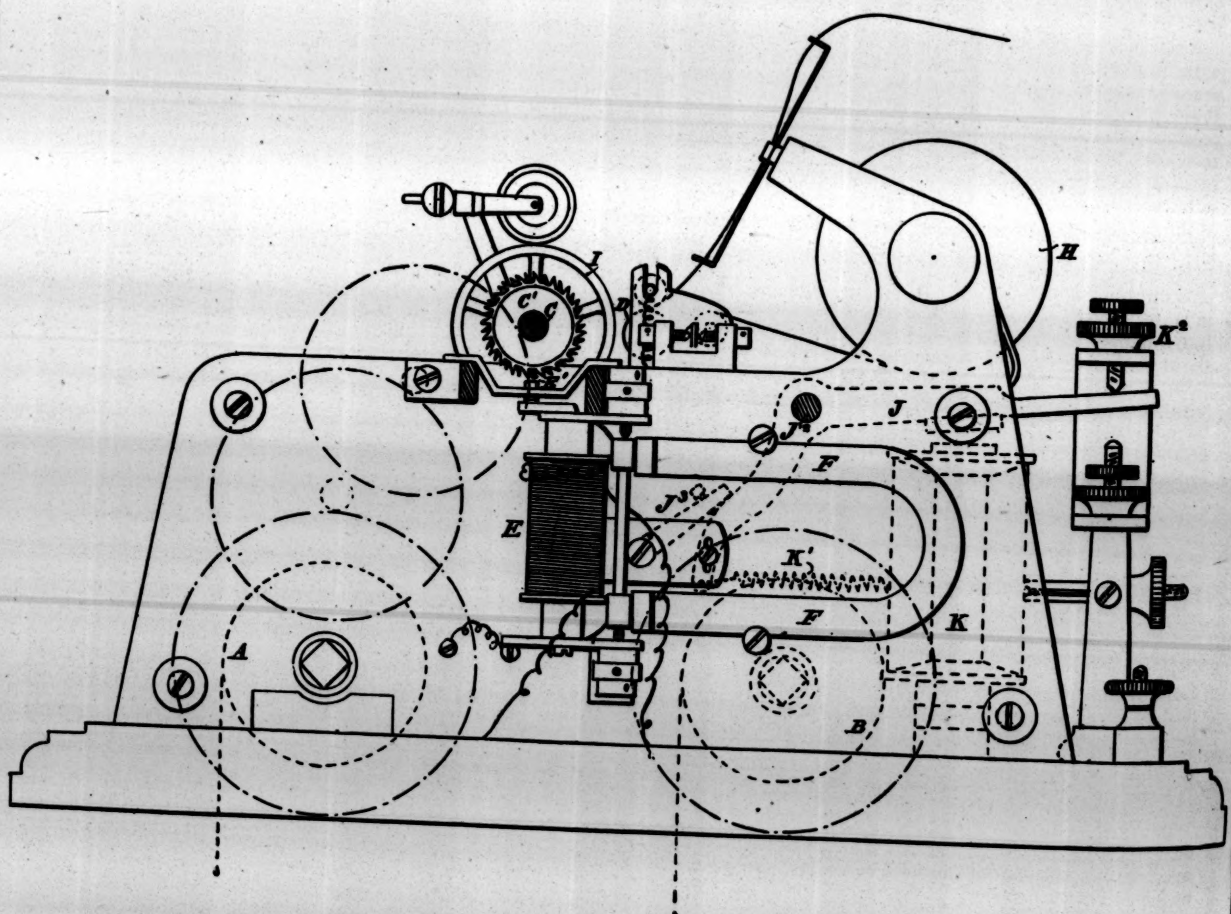


FIG. 3.

Mr. Anders nor Mr. Van Hoevenburg ever carried their machines into practical use. It is probable that they never reached a stage beyond that of being filed in the Patent Office. Mr. Higgins's machine is constructed for *two* line wires, and is very similar in its main points to that of Van Hoevenburg. Judging from his specifications, and from a description published in the *Electrician*, Mr. Higgins has made no attempt to attain to any rapidity of transmission. The use of two wires also seems to a great extent to place any instrument beyond the pale of commercial possibility nowadays.

We think, therefore, that Messrs. Wright and Moore's invention, which employs but one wire, is by far the most satisfactory arrangement yet devised for the object in view. Its construction is free from complication, and, as a necessary consequence, its action is certain and entirely satisfactory.

In perfecting their "column" printer (as the inventors term it), which is shown in general view by fig. 1, Messrs. Wright and Moore have aimed at the attainment of such simplicity as would necessitate little or no departure from methods at present employed in working the tape machine.

To obtain ease and speed of working, two clockwork trains have been introduced, one to revolve the type-wheel, the other to feed the paper upward at the end of each line, at the same time returning the type-wheel to its initial position.

The paper-feeding and type-wheel returning clockwork is released by the action of what may be termed an auxiliary magnet, which is of about two ohms' resistance. To the armature of this magnet are attached two releasing fingers, of peculiar construction, which act upon a pin attached to a pinion at the last position in the train. On charging this magnet sufficiently to attract its armature, the fingers are *merely moved into proper position*, the paper not being fed until the current ceases and the armature is withdrawn by means of a spring. This arrangement, we believe, is entirely new.

The mode of feeding the type-wheel laterally, which is effected by means of two racks, one movable, the other stationary, is also new in connection with printing telegraphs, as far as we are aware, and is a most efficient arrangement.

Step by step printing telegraphs have been constructed with and without clockwork for years, but no great speed of transmission has ever been attained with the non-clockwork instruments. On the other hand, with clockwork, 125 to 160 revolutions of the type-wheel per minute is not uncommon. At 150 revolutions a skilled operator can transmit from 35 to 40 words a minute, practically equalling the Morse, to say nothing of other obvious advantages. Both the "Gold and Stock" and "Commercial" Companies of New York are at present running their "stock tapes" at high speeds—the former at 150 revolutions, the latter at 120 revolutions.

Fair power, about half an ampère of current, and fast working trains with heavy weights are employed for this purpose, but the results are highly satisfactory, and fully compensate for the expenditure of current and cost of perfected mechanism. Indeed, the old American stock machine, similar to that at present in use by the Exchange Company of London, was found to be entirely inadequate to the requirements of a busy day on the Exchange, and the American companies were forced into the adoption of high-speed machines. Clockwork, together with skilfully devised polarised magnets, replaced the sluggish neutral-magnet driven instrument which had outlived its usefulness.

While devising and constructing the column printer all these facts have been kept in view. The inventors have sought to give the *magnets* as little work to do as possible. The clockwork trains, which do the bulk of the work, are *released* by the magnets, the latter acting with an ease and freedom not even attained in the ordinary tape machines. This being the case, it is not unreasonable to assume that the new machine will be quite as fast as the best tape machine, and when the result—a printed page—is taken into consideration, comparison ceases.

We should add that one of the merits of the new machine is the construction of the escapement. In it the faults of the ordinary escapement have been removed, with the result that we get lightness, speed, and comparative *silence* in a greater degree than is attained in any other machine in use. Absence of noise is in itself a very high recommendation.

We come now to the description of the mechanism of the apparatus :—

Fig. 2 is a front elevation, and fig. 3 a side elevation of the mechanism. Fig. 4 shows details of the parts for moving the paper a distance, and bringing the type wheel back to its starting point when a new line is to be commenced.

A, B, are two barrels, each driven by a cord and weight. The barrel, A, by a train of spur gear wheels drives a spindle, C, on which the type wheel is mounted. The barrel, B, by another train of wheels, drives a roller, D, over which the paper to be printed on is led.

On the spindle, C, are two escapement wheels, C^1, into which a pallet, E^1, actuated by an electromaget, E, with armatures polarised by the permanent magnet, F, is made to engage alternately.

When a current of one polarity is sent through the electromagnet the armatures move in one direction, and when a current of the opposite polarity is sent they are moved in the opposite direction.

To rock the armatures, alternate currents are sent through the electromagnet by the transmitting instrument, which may be of any ordinary construction.

The paper to be printed on is led from the roll, H, round the roller, D, and this roller, after the completion of each line, is allowed to be partly rotated as explained further on, to move the paper a distance equal to the distance required between the lines of printing.

Normally the roller, D, is, as usual, a slight distance off from the circumference of the type wheel, I, and each time that the printing of a letter is to take place, the roller is moved towards the type wheel, and the paper where it passes around the roller is thereby forced against the type which is opposite to it. This is done by the roller, D, being rocked at each movement of the printing or impression lever, J. One arm of this lever carries the armature of an electro-magnet, K, and is drawn by a spring, K^1, up to an adjustable stop, K^2.

The alternate currents which pass through the driving coil also pass through the coils of the magnet, K, but are not of sufficient duration to cause this magnet to draw its armature towards itself until when a letter is to be printed a current of longer duration passes, as is well undertood.

The type-wheel, I, is carried by a sleeve, which can be slid endwise along the spindle, C, but turns with it. The sleeve can be moved along the spindle by a fork, which embraces it, and which extends from a carriage, M, which can be slid along a fixed guide rod, N.

The carriage, M, carries two pawls, O (one behind the other), which engage with ratchet teeth cut on the edge of two bars, one behind the other, and the front one of which, P, can be seen in fig. 2. The hinder toothed bar or rack is fixed.

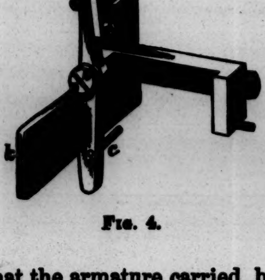


FIG. 4.

Each time that the armature carried by the lever, J, is drawn to the magnet, K, the ratchet bar, P, is moved a distance endwise, and the pawl, O, which rests on the rack teeth instead of resting on the tooth, it was previously resting against, rests upon the next tooth and when the printing lever returns to its original position, the ratchet bar is shifted in the opposite direction by a spring (not shown in the fig.); it then drives back the pawl and the carriage, M, with it, thereby shifting the type-wheel sideways; as it is shifted sideways, the hinder pawl slips over the hinder rack, and drops into the next tooth of the rack, so that the slide is prevented from moving back.

In this way the carriage can be traversed step by step from one side of the machine to the other. When it arrives at the end of its traverse, it is brought back to its starting position by a cord, which passes from it to the circumference of a spring barrel. To allow the cord to draw it back, both pawls are simultaneously lifted and withdrawn from the rack teeth of the bars. This is done whenever the printing lever is moved at the time when a blank space on the circumference of the type-wheel is towards the paper, and when a special key of the transmitting instrument, which causes the current strength to be increased, is depressed.

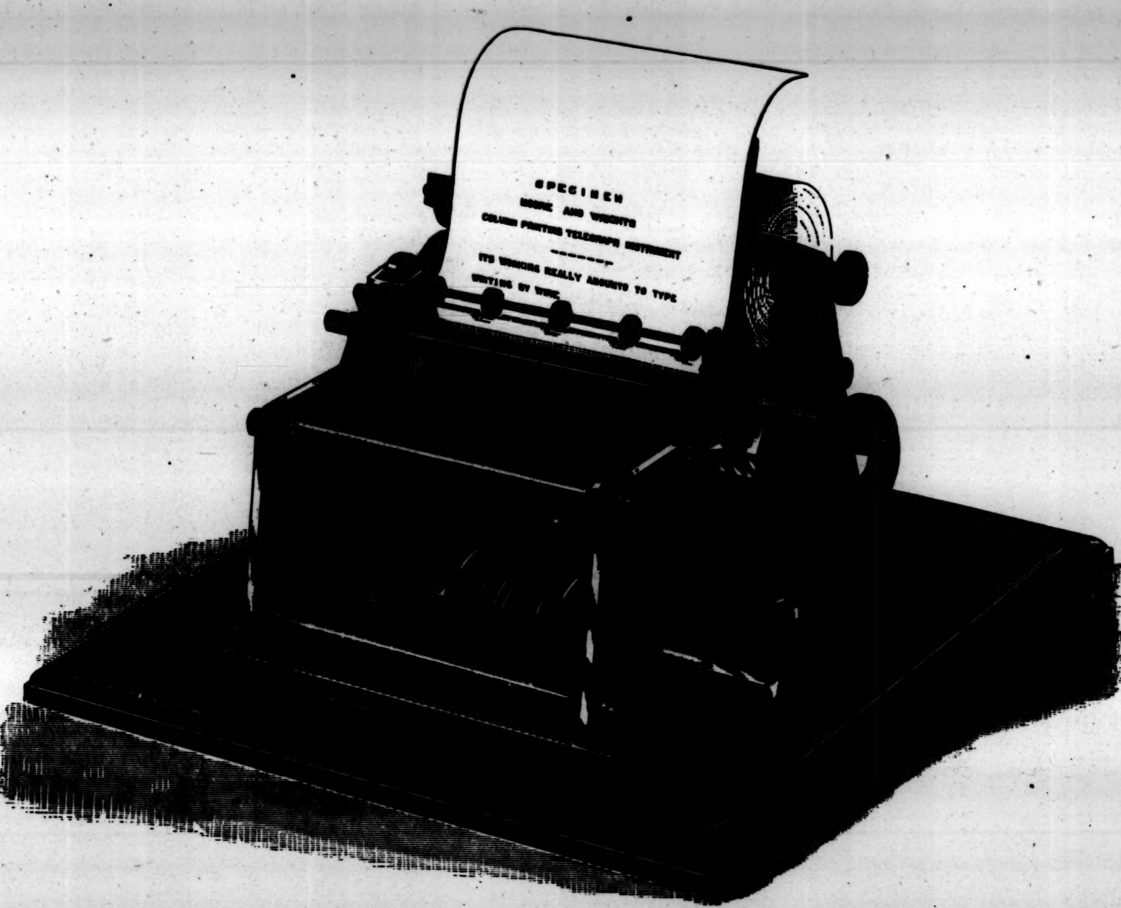

SPECIMEN
AND WRIGHTS
COLUMN PRINTING TELEGRAPH INSTRUMENT
ITS WORKING REALLY AMOUNTS TO TYPE
WRITING BY WIRE

FIG. 1.

The movements are effected in the following manner:—In circuit with the line is an electro-magnet, K^3, whose armature, *k* (see also fig. 4), is held back by a retractable spring, *s* (attached to the pin, *c*), whose tension is such that it cannot be overcome except by a considerable increase in the normal current strength. To the armature are fixed two blades or stops, *a* and *b* (fig. 4), one of which, *b*, is movable, and is kept pressed in the position shown by a spring. A pin, *e* (fig. 2), fixed to and projecting at right angles to the axle of a pinion, *p*, which is in gear with the clockwork driven by the barrel, B (fig. 3), normally presses against the movable blade, *b*, and keeps it back in the same plane with the fixed blade, *a*. When the armature, *k*, is attracted, and the blades moved, the pin, *e*, slips from blade *b* to blade *a*, and blade *b* jumps forward under the influence of the spring pressing against it. When the armature is drawn back, the blades are again shifted sideways, but in the opposite direction; the pin, *e*, on the pinion axis then comes at the back of the movable blade, and there being nothing in the way of the pin, the pinion to which it is fixed turns until the pin comes on to the face of the blade, and brings it back into its original position; thus the further rotation of the pinion is prevented. When the train of wheels connected to the pinion is thus allowed to turn, it revolves the paper roller, D (fig. 3), and shifts the paper the distance that is required to be between the lines. At the same time it turns a notched or cam wheel, and one of the projections upon the cam wheel acts against a lever, and rocks it on its centre. This movement of the lever causes a bar to be lifted which is parallel with and by the side of the two ratchet bars, P, by which the the type-wheel is traversed sidewise step-by-step along its axis, as before explained. When the bar is lifted it lifts both of the pawls which engage with these ratchet racks, and the type-wheel is drawn back into the position for beginning a new line, the bar being held up by a spring catch until the type-wheel has been brought into this position; the slide which moves the type-wheel then comes against and liberates the catch, and the bar is drawn downwards by the action of a spring. The means for bringing the type-wheels to "unison" is the well-known arrangement devised by Smith many years ago.

ELECTRIC LIGHTING IN NORWICH.

ON the recommendation of the Market Committee, permission was given to Messrs. Laurence, Paris and Scott to erect, to the satisfaction of the city engineer, a wrought iron post in the Bull Ring, near the Agricultural Hall, for the purpose of carrying two electric light and power wires, Messrs. Laurence, Paris and Scott taking upon themselves all liability in regard thereto and undertaking to remove the post and wires on receiving three months' notice to do so. A report was received from the Electric Lighting Committee to the effect that they did not consider themselves warranted in recommending that the Corporation should undertake the lighting of the city by electricity, but they should forward any scheme for the purpose.

Mr. **SQUIRRELL** said he was the father of the report, and added that there were two courses to be laid down —one was that the council should take up the electric lighting of the city, and the other was that they should support any sound company that would do the work. As a matter of fact, it would be the best economy for the city to undertake it, the cost being about £15,000 or £20,000; but in the face of the large expenditure for sewerage, &c., that was about to fall upon the rates, he could not recommend the adoption of this course. He dismissed the idea, however, that the city was so overburdened with debt as was represented. The debt in Norwich amounted to £3 per head, therefore Norwich was not so overburdened with debt as some people tried to make out. There was a large demand for the new light, and he had in his hand a list of 60 persons who had applied for the light to be introduced into their shops. This was a fact that ought not to be lost sight of, and the council ought not to obstruct the development of this new industry.

It was resolved to consider the question at the next meeting of the council.

A SYNTHETIC STUDY OF DYNAMO MACHINES.

(*Continued from page* 179.)

VI.—ARMATURES IN PRACTICE.

THE laws of induced E.M.F. have been formulated in a former part, and we have now to consider how conductors are arranged in practice in order that the requisite induction may be obtained. It will be necessary to restrict our considerations in the present part to the magnitude and character of the induction, and to leave for future study such matters as the effect produced by currents flowing in the armature conductors. In the following paragraphs it is assumed, therefore, that the armature circuit is not closed, and that though E.M.Fs. are induced in the conductors, there flow in them no currents.

Armatures may be classed into those having an iron core on which the conductors are wound or laid, and those having no iron where the coils are supported on non-magnetic material. The latter are only employed in machines of Class I., giving currents which alternate in direction, and to these we shall give our attention first. In machines of this class the magnets are excited from a separate continuous current machine.

19. *Armatures without iron cores.*—We have in a former article considered the E.M.F. induced in a rectangular frame moving in an intermittent field, and in the Mordey alternator, figs. 46 to 48 (page 628, vol. XXIII.), we have an example of how such a field is practically produced. The magnet of this machine is shown in figs. 46 and 47, and consists of a wrought iron cylindrical core on which the magnetising coil is wound, with a heavy cast iron divided pole piece at each end, which forms a number of equidistant poles lying in a circle, and bent over so that the north poles come opposite the south poles, a small interpolar space for the armature coils being left between them. The armature consists of a series of thin flat coils, tapering at the sides and lying close together in a circle, there being twice as many coils as there are magnet poles. Let a few of these coils be shown by A, B, C, D and E, fig. 68, N_1, N_2, N_3 being three of the magnet poles. Assuming that all the lines of force from N_1, N_2, and N_3 pass through the respective coils as the magnet poles sweep past them, it is easy to calculate the average E.M.F. of the machine. Confining our attention to coil C, if N be the number of lines between each pair of poles, or in each group, it is evident that from the time that N_2 leaves C till the time N_1 takes its place, the magnet rotating in the direction of the arrow, the whole of the lines in one group have been subtracted, and the whole of the lines in the next group added, or if we call N the number of lines of force in each group, during the movement the number of lines cut has been 2 N. It will be seen that the coil C is in the same condition when N_1 is in front of it as it was when N_2 occupied the position; it has consequently gone through a complete cycle of induction, and with a further rotation of the magnet poles a similar cycle of operations is gone through. If we call n, as before, the number of cycles per second in the case of a moving field constituted by equidistant groups of lines in the same direction, the average E.M.F. in volts per coil is

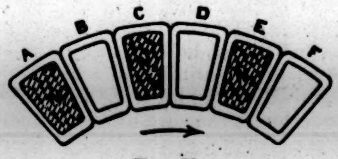


FIG. 68.

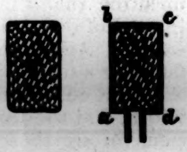


FIG. 69.

$$E_{\text{average}} = \frac{2\,N\,n\,c}{10^8},$$

c being the number of convolutions in the coil. It is evident that n the number of cycles must be equal to the product of the revolutions per second and the number of poles. Calling the revolutions s, and the number of poles p, we have, then, for the E.M.F. in volts:

$$E_{\text{average}} = \frac{2\,N\,p\,s\,c}{10^8}.$$

If for the revolutions per second we substitute in the equation the revolutions per minute, we must divide the denominator by 60, and to obtain the average E.M.F. for the whole machine we must, since the above is for one coil only, multiply by the number of coils in series.

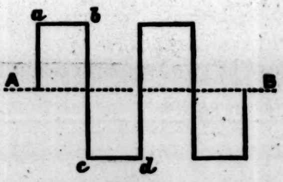


FIG. 70.

So much for the *average* E.M.F., but it is important to know how the E.M.F. varies from moment to moment. If we have a rectangular coil, a, b, c, d, fig. 69, and cause to pass it a number of poles, N_1, N_2, &c., of the same sign, spaced equi-distantly and of width equal to half their pitch, we get for the induction a number of straight lines, as in fig. 70, the E.M.F. rising at once to its full value, being maintained there for a certain time, and as suddenly falling to 0, to rise instantaneously in the opposite direction. In the

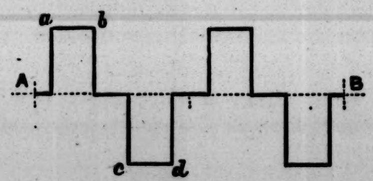


FIG. 71.

diagram is shown the induction for two complete cycles, there being for each cycle two E.M.Fs. in opposite directions, graphically represented on opposite sides of the line, A, B. If the pitch is made three and a half times the width of the pole, and the width of the coil equal to half the pitch, the form of the diagram is altered somewhat, and we have the induction as shown in fig. 71, there being intervals of inactivity between the alternate E.M.Fs.

Now, in an actual machine there are present conditions which modify this induction. In the first place, the cross-section of the field is not strictly confined to the area of the polar surfaces, and we have a fringe of field shading off gradually to nothing for some little distance from the edge of the surface, this meaning that the corners of the induction diagram, instead of remaining square, are rounded off to a certain extent. Again, the coil, instead of being simply a rectangular single wire, consists of a number of wires laid together, occupying, as shown in fig. 68, a considerable width, and the total induction is the sum of the inductions in all those separate wires. A third reason for modification in the induction diagrams is that, if the coils are arranged in a circle, as in fig. 68, by reason of their tapering form, the rate of cutting lines increases gradually, those lines coming from one corner of the field entering the coil first. Our meaning is made clear by fig. 72, where C is a coil and N_1 is a pole moving in the direction of the arrow, this pole being shaped to correspond with the opening in the middle of the coil. It will be noticed that lines from the right hand top corner of the pole would be entering the outside convolutions of the coil in the position shown, while the bottom corner is yet some distance off. The effect of this gradual introduction of the field is, of course, to round the corners of the induction diagram still further.

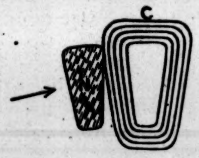


Fig. 72.

Though it would be a very laborious task to find the total induction at every instant for a coil of the form shown in fig. 72, it is instructive to make an approximate determination for a simpler shape, and for this purpose we will select the form of coil shown in fig. 73. This coil consists of two rectangles connected in series,

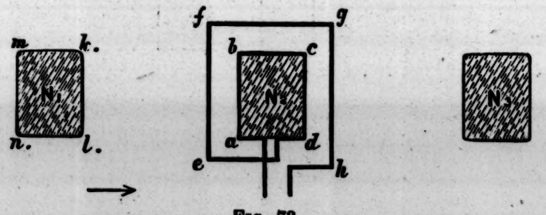


Fig. 73.

the inner being of equal area to the polar faces, N_1, N_2, N_3, while the outer is of width equal to half the pitch, as in the Mordey alternator. We shall also assume, for simplicity, that the poles move horizontally across the coil. Taking the induction in the outside rectangle first, if the poles are moved from the position shown there will be no E.M.F. generated until the side, *c*, *d*, arrives at *g*, *h*. When this position is reached the side, *g*, *h*, will commence to cut lines of force, and an E.M.F. will continue to be induced until *b*, *a*, arrives at *g*, *h*. If the distance *a*, *b*, on the horizontal line, fig. 74, represents the position of the poles during a complete cycle, the movement during which there is no induction would be represented by *a*, *f*, and the rise by the dotted line, *f*, *d*, on the assumption that the field is confined strictly to the area of the poles. On account of the spread in the lines, the induction is, however, modified, as shown by the rounded full line, the diagram showing the result for two complete cycles. After *b*, *a*, has reached *g*, *h*, there is a period of rest, the E.M.F. falling as at *e*, *g*, fig. 74, and this continues until *k*, *l*, the succeeding pole, arrives at *f*, *e*, when an E.M.F. in the opposite direction is induced. The induction is sustained until *m*, *n*, arrives at *f*, *e*, and from that position, until the pole, N_1, takes the position N_2 to complete the cycle, is a period of rest. The distance from *a* to *b*, in fig. 74, represents the cycle. Now take the inside rectangle. On moving the poles from the position shown this becomes at once active, and the E.M.F. would instantaneously attain its full value, as shown by the dotted line, *a*, *d*, fig. 75, if there were no spread

Fig. 74.

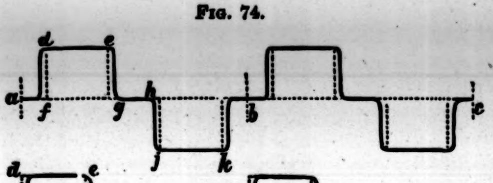


Fig. 75.

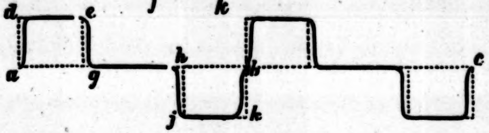
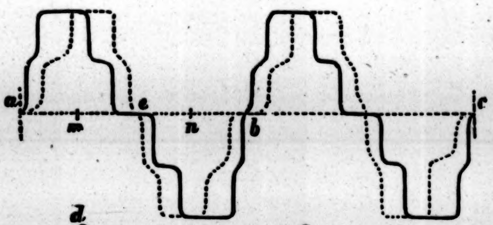


Fig. 76.



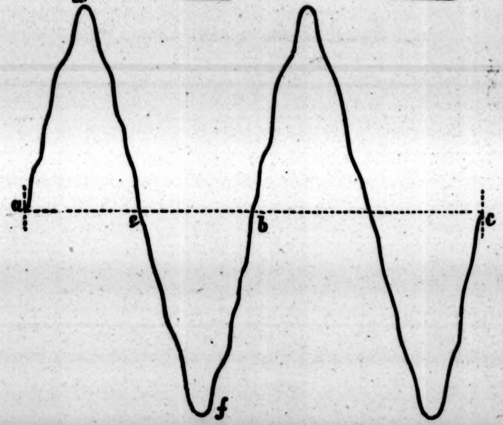


Fig. 77.

of the field. The effect of spread is to make the E.M.F. rise gradually, and to represent the induction we have the full rounded line in the fig. The induction will be sustained until *a*, *b*, arrives at *c*, *d*, after which there will be a period of no activity. When *k*, *l*, arrives at *a*, *b*, an E.M.F. will be induced in the opposite direction, and this will be maintained until *c*, *d*, is reached, when the E.M.F. falls again to 0, and the cycle is complete. It will be seen that the curve in fig. 75, representing two cycles for the inner rectangle, differs considerably from that for the outer rectangle in fig. 74. In both cases the dotted lines give the rise of induction on the supposition that there is no fringing of the field, the full rounded line being the induction as modified by the presence of a fringe extending beyond the poles. Now, since these two rectangles are coupled in series, the E.M.F. of the coil will be the sum of the two, and the total induction will be found by adding the induction in figs. 74 and 75. In fig. 76 this is done, and the full line representing their sum shows the total induction curve for this coil to be of an unsymmetrical character. If instead of a coil having two convolutions only, we had one in which the several convolutions filled up the space between *a*, *b*, *c*, *d*, and *e*, *f*, *g*, *h*, we should get two nearly symmetrical waves occupying unsymmetrical positions as regards the cycle, the curve having steps so numerous that it would lose its rippling character, and become practically a continuous wave without ripples. For a coil as in fig. 68 the curve modified by the magnetic fringe and its tapering shape is shown in fig. 78.

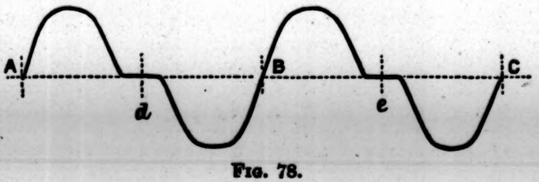


FIG. 78.

But though the induction curve of each individual coil may be unsymmetrical, the total induction curve of the machine may be perfectly symmetrical. In the alternator we are considering there are twice as many coils as there are magnets, and it follows that each alternate coil is in phase exactly half a cycle behind the others. In fig. 76 the dotted line shows the induction in the two wire rectangular coil adjacent to that of which the induction is shown by the full line, and if the coils are coupled in pairs, so that the E.M.Fs. are added, the induction shown by the full line and that shown by the dotted line have to be added to give the induction of the pair. This has been done in fig. 77, which gives the E.M.F. for a pair of adjacent coils. It will be noticed that the curve is now perfectly symmetrical, and that the ripples have become less pronounced.

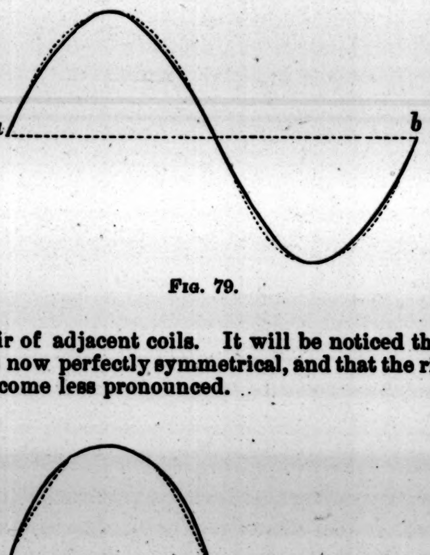


FIG. 79.

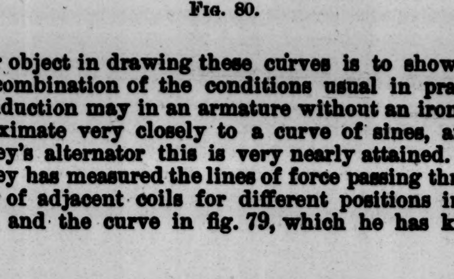


FIG. 80.

Our object in drawing these curves is to show that by a combination of the conditions usual in practice, the induction may in an armature without an iron core approximate very closely to a curve of sines, and in Mordey's alternator this is very nearly attained. Mr. Mordey has measured the lines of force passing through a pair of adjacent coils for different positions in the cycle, and the curve in fig. 79, which he has kindly handed to the writer, shows the results. The full line gives the lines passing through the coils, the dotted line being a curve of sines. The full line represents the total resultant flux of lines through all the convolutions of a pair of coils, and the E.M.F. is at any instant proportional to the rate of change in the number of lines or to the slope of the curve. It will be seen that the full line at one part lies inside the curve of sines, and the E.M.F for a cycle, as deduced from fig. 79, is shown in fig. 80, the dotted line again representing a sine curve.

(*To be continued.*)

ELECTRIC LIGHTING IN INDIA.

RULES subsidiary to the Electricity Act of 1887 have lately been issued by the Government of India (in the *Gazette of India*, dated 19th January). These rules are drawn up chiefly with reference to security of life and property, and to the protection of telegraph and telephone lines from interference by strong currents. In framing the rules those issued by the Institution of Electrical Engineers have been largely drawn upon. It is not the intention of the Government of India to place any restrictions in the way of electric light and power undertakings, and stipulations as to "provisional orders" and powers of local bodies for compulsory purchase are conspicuous by their absence. It is open to any public company, with the consent, of course, of the local municipal committee, to light any large or small area in India, from any source of power, and for any period, provided the work is safely carried out and conducted thereafter. In 1882 the Government thought it necessary to order that all wires for conveyance of light and power currents should be put underground, and there is little doubt that this stipulation operated unfavourably against the Electric Lighting Company then established in Bombay. The science was then not only in its infancy but the cost and difficulty of maintenance of underground cables in a place like Bombay would have been enormous. This proviso has been abandoned, and wires may be carried overhead provided good headway is secured, and they are carried a respectable distance from telegraph wires. Again, however, in special localities a local board may require them to be buried. There are certain conditions in the large towns of India which are unfavourable to economical installations of electric lighting: distances are great, private houses are spread over large areas, the large shops which might use the light close at 7 or 7.30 p.m., and an electric lighting company must look for its profits to buildings such as hotels, clubs, theatres, and public offices, such as the Post and Telegraph, where work is conducted at night. Then again, European investors are shy of investing capital in the East. At present the working installations in India are very few. In referring to the Viceregal Lodge at Simla, the Bombay Yacht Club, the Madras Club, the Eden Gardens, and a few mills in Calcutta, perhaps all have been named. A few native princes have small plants, but they are seldom used, probably for want of skilled attendance. With judicious management it would seem that enterprise in this direction will find success in India; but a company burdened with large capital, represented mostly by patent rights, will no doubt find it difficult to realise profits.

E. O. WALKER.

Electric Light and the Prince of Wales.—The Prince of Wales's private railway carriage, which is believed to be the finest vehicle of the kind in Europe, is fitted with a powerful electric-lighting apparatus of the most approved description. It was built by the South Eastern Railway Company, on whose line it is used more than on any other, owing to the frequent journeys of the Prince to and from the Continent.

MEMORIAL TO G. S. OHM.

SOME of the Professors and other leading men of Munich have proposed the erection of a statue of George Simon Ohm in that city.

A meeting was held on the 31st of January, under the presidency of the Right Hon. Lord Rayleigh, at the meeting-room of the Royal Society, for the purpose of enlisting the co-operation of English men of science in the scheme.

A committee was formed of members of the Royal Society, with Lord Rayleigh as its president, to co-operate with the local committee appointed in Munich, by whom an appeal has been issued which sets forth that—"In the year 1889 a century will have passed since the birth of the physicist George Simon Ohm (born at Erlangen, March 16th, 1789; died as professor at the University of Munich, July 6th, 1854). His discovery of the laws of the electric current was not only a performance of the first rank from a scientific point of view, but it soon became of the highest practical importance. Ohm's laws, by shedding a brilliant light on a subject which had hitherto been enveloped by the deepest darkness, replaced by well-calculated methods unsafe and doubtful theories, and thereby rendered that powerful natural force, electricity, serviceable to the civilising aims of mankind. The wonderful advances in the application of the electric current, in telegraphy, in electric lighting, and in all other electro-technical branches of which we have been the admiring witnesses in the last decades, could only be accomplished on the safe basis of Ohm's laws. The vast importance of Ohm's discoveries is universally recognised nowadays. George Simon Ohm was the son of an intelligent blacksmith, who had for years devoted his leisure to mathematical and philosophical studies with such success that he was able himself to initiate his son in the mysteries of mathematics. His son, following in his footsteps, was mainly self-taught as far as mathematics and physics were concerned, and trained in the school of independent thought, he was the more fitted to enter upon the career of a scientific explorer and discoverer. But to the fact that he belonged to no special school or set, as well as to his modest and retiring habits, it must be ascribed that his own countrymen found out his value almost too late. We may say, in fact, that only now, more than thirty years after his death, his name has found that universal recognition which it deserved during his lifetime. Ohm was engaged in various places as teacher of mathematics and physics without being able to obtain an appointment as university professor, a position for which the scientific turn of his mind and his excellent teaching capacities so eminently qualified him. From Gottstadt and Neuenburg, in Switzerland, he returned to his native place, Erlangen, where he was for a short time engaged as private tutor at the university. In 1827 he published the chief work of his life, "Die galvanische Kette mathematisch bearbeitet" (The Galvanic Chain Treated Mathematically), and soon after that he resigned his mastership. For six years he retired into private life and was then appointed professor, and soon after rector of the Nürnberg Polytechnic School. At last, when he was sixty years of age, five years before his death, he was appointed professor at the Munich University." The Munich committee conclude their memorial by making an appeal to all those who acknowledge as a general obligation to do honour to grand accomplishments furthering the moral and physical development of mankind to contribute their share towards the erection of a monument worthy of the great German philosopher. In England Prof. G. Carey Foster and Prof. John Perry have consented to act as secretaries and to receive subscriptions.

Ohm's work on the laws of electric currents was published at Berlin in 1827. It was translated and published in English in 1841, and in 1843 Wheatstone's paper "An account of several new Instruments and Processes for determining the Constants of a Voltaic Circuit," read before the Royal Society, called attention to the importance of Ohm's work. In 1861, at the Manchester meeting of the British Association, Sir Charles Bright and Mr. Latimer Clark suggested the use of the term "ohmad" or "ohm" to express the unit of resistance. In 1881 the ohm was adopted as an international standard, at the Congress of Electricians held in Paris.

REVIEWS.

Les Compteurs d'Energie Electrique. By E. HOSPITALIER. Paris: G. Masson.

This pamphlet is a reprint of articles that appeared lately in our French contemporary *l'Electricien.*

It is sometimes said that every man of ability has some fad. M. Hospitalier's is units and classification, and a very good fad it is. He falls foul, and very rightly too, of our absurd "Board of Trade Unit," and points out that 1,000 watt hours might better be called a kilowatt hour. The custom of talking of so many kilowatt hours as so many "units" is loose and incorrect. Volt, erg, coulomb, second, &c., are units. A hundred unit dynamo would strictly speaking be a contrivance that gave a collection of say a volt, an erg, a joule, a dyne, &c., up to 100 different units. It is good to see ourselves as others see us, and we have often only to read M. Hospitalier's criticisms to see what a muddle-headed people we are. The matter is made worse by the recent change in the Board of Trade unit, a change which is of no real advantage, as it is as easy to write 100 as 10, and which will cause useless confusion. In addition we sometimes call 1,000 watt hours a unit, and at others 1,000 watts is called a unit.

M. Hospitalier classifies meters according to what they mete. They are divided into (1) those that do not mete anything, as in such cases as lighting a fixed number of lamps for a fixed time every week no meter is needed; (2) those that measure $\int dt$, which are clocks that go when the fixed number of lamps are lighted and stop when they are not; (3) $\int c\,dt$, or coulomb meters; (4) $\int E\,dt$, or volt hour meters, which are not much, if ever, used; (5) $\int E\,c\,dt$, or joulemeters, sometimes called ergmeters, or energy meters.

We have the ordinary Edison zinc meter, and the scale tipping form described. We do not think the latter is in use.

Under the head of motor-meters we find Ferranti's well-known meter clearly described, and an ingenious meter of Lippmann's, but we do not meet M. Faure's name, which deserves honourable mention in this connection. We also do not think Messrs. Ayrton and Perry are accorded enough credit for their work. They appear to have patented the motor meter, and then waited till it was wanted. There was no demand for meters at that time.

Forbes's meter is well defined, but we would like to know if it is in commercial use. The author points out that this meter integrates the square root of the mean square of the current, which is what a well-conducted meter should. We think the term "virtual" is better than "square root of the mean square of the, &c."

The Schallenberger meter is excellently described, but the theory of its action, which is, we believe, the commonly accepted theory, appears to us to be wrong. M. Hospitalier regards the wrought iron disc as a magnet magnetised by one coil and deflected by the other simultaneously, the instantaneous force varying as the product of the magnetisation and deflecting current, that is, as the square of the instantaneous current in the main circuit. Now, if the two fields increased and decreased simultaneously the iron core would simply be magnetised in the component direction, it would not be rotated at all. If the two coils were in series, no rotation would result. We believe the rotation is partly due to persistent magnetism, and partly to Foucault currents in the disc, a time lag between the currents in the two coils will then cause the rotation.

Aron's clock meter in its several forms is given at some length; but the description of the Cauderay meter, good as it may be, is out of all proportion to the value of the apparatus.

The author does not fully realise that meters to integrate $\int E\,d\,t$ are little more than time counters. E does not vary as c generally does. These meters are only used in series lighting; if a meter is put on every group of lamps the meter is really a time counter. If the groups of lamps are variable, of course E varies by leaps equal to the electromotive force on a group of lamps.

The meter of M. Lucien Brillié is described at great length also. It is exceedingly complicated, in fact it appears to be a sort of central station in itself; but according to carefully made tests it seems to be very accurate for a meter.

We have reviewed this little book at some length, because meters seem to be attracting considerable attention at present. The book is really above criticism, being a clear and logical description of the meters that are beyond the experimental stage. We think too little has been said about many of the American meters; and there are several others which are worthy of discussion.

The Voltaic Accumulator: an Elementary Treatise. By EMILE REYNIER. Translated by J. A. Berly. E. and F. N. Spon, London.

A few months ago we were favoured with a copy of the French edition of M. Reynier's work; now we are in possession of an English translation. If we had been asked whether M. Reynier's book was worth translating we should certainly have said *No*, unless it was very considerably improved, because the original had two great faults. First, the author has completely failed in producing what he professed to produce—a practical treatise on the subject of accumulators. Secondly, the book treats but scantily of what has been done in England in the way of secondary batteries, and what there is refers to facts as they existed several years ago. M. Reynier ignores not only the modern investigations of Gladstone and Tribe, Dr. Lodge, Reckenzaun, Rühlmann, and Dr. Waltenhofen, but he also omits the recent improvements of all the most successful manufacturers in the world. The original edition is essentially French; the author has every reason to be proud of the fact that France has furnished several prolific inventors and investigators, but he should not have ignored the equally important fact that most of the practical applications of secondary batteries were made outside his own country. In his preface M. Reynier pretends a great deal—he says, for instance: "The attentive reader will acknowledge my impartiality. Should he require to find in this book a known system, he will find it on condition of seeking for it under its proper designation." We must confess that we have not been able to find many things we expected to find, and we notice page upon page taken up with matter which could have been condensed into a few lines to the advantage of the seeker after useful knowledge. M. Reynier's style of writing is seldom clear, and the translation of it is often abominable. We give a few examples to illustrate the fearful jumble of words, which in some cases are not merely obscure, but positively inappropriate. Thus our "impartial" author gives the following "*Classification of Accumulators: The voltametric systems capable of storage are thus reduced to the number of four; whence four genera of accumulators.*

"*Each of these genera comprises various combinations, modes of forming, &c., giving rise to numerous species. The existing accumulators must therefore be divided into four genera*, i.e.:

"1. *The lead sulphuric acid genus, to which is attached the name of the learned Mr. G. Planté, who discovered it and its first species. The Planté genus is the original one, and most important of all; it is almost exclusively used in industrial practice.*

"2. *The lead sulphate of copper genus, very little in use.*

"3. *The lead sulphate of zinc genus, very little used until now, but interesting owing to its high electromotive force and some special properties.*

"4. *The copper alkaline zincate genus, the first appearance of which has recently been noisily proclaimed.*"

Throughout the book we find most unusual expressions and cruel definitions. Who has ever heard of "autogeneous soldering," "electromotive force due to heterogeneity," "sulphatation of electrodes," "anteriorities," "caustic lixivitations," "regimens of charge," "fugitive surelevation of secondary electromotive forces," "plates becoming disaggregated," in connection with secondary batteries? "*Land-carriage of energy*" is defined thus: "It is the translation effected on land, on carriages, or on wagons. This method, in use for many years, will render great services when it is logically practised with light accumulators. Locomotion by accumulators gives us the spectacle of energy effecting its own translation, with an additional weight, which might consist of charged batteries travelling with their disposable energy." Later on we read "*Water-carriage of Energy.* It is the translation of energy on water. Floating is analogous to land-carriage. It must, however, not be forgotten that *petite vitesse* water propulsion only requires a very feeble expenditure of work; if the accumulators are capable of vehiculating their own energy they can carry it on water at a smaller sacrifice of the work embarked."

Comment upon the mode of classifying accumulators or the choice of terms throughout the book is unnecessary after giving the above quotations. When writing of the life of cells the author says "the redemption of a battery of accumulators (the positive plates of which only being subject to frequent renewals) would vary from 20 to 100 per cent. per year." This can only be the case with the types described in M. Reynier's book, for we have sufficient evidence that on this side of the Channel storage batteries are produced which have a much smaller percentage of depreciation.

The book is well printed and nicely bound, but this is all we can say in its favour. We should be sorry to recommend it to the student of electrical science, for he would waste time in storing his mind with erroneous statements, faulty terms, and slipshod definitions. The expert, on the other hand, will readily detect that this compilation is an attempt to advertise the author and his favourites, together with their doubtful productions.

Progress of the Thomson-Houston System in America.—We have received from Messrs. Laing, Wharton and Down a beautifully printed and illustrated catalogue of the machines and appliances manufactured by the Thomson-Houston Electric Company, at the end of which is a table showing the increase in the number of companies formed to work this system locally, and the number of arc and incandescent lights in operation at various dates during the last five years. With reference to the arc system, the statistics show that on October 1st, 1883, there were 22 companies and 1,653 lights, while on the 1st January of the present year, the number had increased to 435 companies, using 52,000 lights. The figures relating to incandescent lighting, which extend over two years only, show even a more rapid development. On January 1st, 1887, there were 29 companies and 11,275 lamps, whilst at the present time there are 175 companies and 97,067 lamps. The Thomson-Houston Company makes the bold assertion that "at no city in the United States has it ever competed for city business that it has not been awarded the city contract," and that during the past year it "has installed by far a greater number of local company plants in different parts of the United States than all other electric lighting companies combined." The remarkable progress of this system is said to be due to the simplicity of its apparatus, and the economy in working cost as compared with others.

NOTES.

Proposed Electric Lighting at Okehampton.—At the last meeting of the Okehampton Town Council the Finance Committee reported with reference to Mr. Geen's proposal to light Fore Street by means of electricity, that it was unable to recommend the Council to consider any such application affecting only a limited area. Mr. Passmore said that if Mr. Geen's price was lower than that of gas it was their duty, as guardians of the public purse, to endeavour to save the difference. Alderman Geen said he had no authority for making an offer, but it was generally understood that a 16-C.P. electric light equalled an ordinary gas light. The largest amount for one of those lights was 25s. a year, to remain until midnight, so that if they wished to make a comparison they had 25s. against £2 3s. 9d. or £2 4s. 9d. at present paid for gas lamps. Eventually the suggestion of the Committee was adopted, a motion to refer the question back for further consideration being defeated. The Mayor said that no doubt if Mr. Geen proposed to light the whole of the town the matter would be reconsidered.

Underground Wires at Bath.—At the last meeting of the Bath Corporation a discussion took place on the question of underground wires. A resolution was moved by Mr. Jolly to the effect that it was desirable in the interest of the public to have the electric lamps supplied by means of underground instead of overhead wires, and that it should be referred to the Electric Lighting Committee to so far vary the present contract with Mr. Massingham as to supply the area by means of underground wires at £25 17s. 6d. per annum per lamp, and to allow a period of twelve months instead of six for the completion of the electric lighting, and such other alterations as might be necessary in the contract. The proposer of the resolution said that he had had several conversations on the subject with Mr. Massingham, who was ready to stand to the alternative arrangement offered in the first instance, viz., that at £4 extra per lamp he would supply the underground system. More than that, he was glad to find that supposing the latter were adopted Mr. Massingham would still be able to accomplish the work in six months. He contended that overhead wires would spoil the architecture of Bath. Mr. Farwell seconded. Mr. Cox said that with overhead wires the cost would be £575 a year more than was paid for gas, and it was now proposed to pay another £324. An amendment to the effect that the matter should be remitted to the Electric Lighting Committee with a view to their arranging with Mr. Massingham for the erection of six lamps with overhead wires in order that a correct idea of their convenience might be formed fell through, and Mr. Jolly's motion was then agreed to.

The Electric Light in Perth.—Messrs. P. and P. Campbell, of the Perth Dye Works, have had two new alternating current dynamos fitted in connection with the electric lighting of their works, for the purpose of securing light in case of a breakdown of the large engines. Eight extra lamps have also been fitted up in the dyehouse. Messrs. Campbell have now 40 arc lamps and 100 incandescent lamps in their works. The dynamos and lamps were fitted by Messrs. Norman and Sons, Limited, Glasgow.

Electric Lighting in Newcastle.—At a meeting of the Newcastle City Council last week Mr. Winter presented a report from the Town Improvement Committee relative to applications for consent to licences to supply electricity in Newcastle under the Electric Lighting Act, 1882. The Committee recommends the Council to consent to the applications by the companies to the Board of Trade upon certain conditions as to the laying of mains and the supplying of and charging for current being complied with.

Electric Lighting of the Strand.—At a meeting of the Strand District Board of Works last week, the Lighting Committee brought up a long and important report dealing with the proposals for the lighting of the district by electricity. The first portion of it dealt with applications on behalf of the Electrical Power Storage Company and Messrs. Koerber for consent to obtain Provisional Orders—the latter for the supply of electricity in the immediate neighbourhood of Soho. Both of these, the committee recommended, should be refused. The draft Provisional Orders, as applied for, were open to serious objections; they contained no effectual provision for securing an adequate and continuous supply of light, and insufficient provision whereby such light could be enforced. Under their clauses, considerable interference would take place with the streets, and the obligations with regard to the supply proposed to be undertaken were somewhat illusory. The orders were in fact drawn principally in the interests of the companies, and without sufficient regard to the users of the light. The committee caused applications to be made to the responsible parties applying for powers, and in the result one of them—the Metropolitan Electric Supply Company—intimated that they recognised the importance of the objections made on behalf of the district, and that they were willing to adopt any such form of agreement or arrangement as might, in the opinion of the committee, afford a solution to the electric light question in such manner as would be satisfactory to the consumers. The committee held several sittings, and carefully considered the whole question, and in the end, drew up an agreement with the company mentioned, which they now recommended to the board for adoption. The agreement differed materially from the Provisional Orders applied for by other parties, and was framed in the interest of the district. Among other clauses were those which limited the interference with the thoroughfares, to the pavements, or the roadway near the pavements on either side, and secured that the interference should be as light as possible, and to take place at convenient times. There was some prospect, the report continued, of having the electric light by the ensuing winter, as the company would, if the board confirmed the agreement with them, immediately undertake the work. The committee recommended that the seal of the board should be affixed to the agreement mentioned with the Metropolitan Electric Supply Company for supplying electricity in the Strand district. The recommendations were agreed to unanimously.

London and the Electric Light.—The Kensington Vestry last week decided to accept an offer of the Kensington Electric Light Company to erect and light several arc lights by way of trial within the district of the Vestry, in continuation of similar experiments about to be made between De Vere Gardens and Queen's Gate, Westminster.

The London Electric Supply Corporation have met the objections of the Rotherhithe Vestry, which now consents to the application of the Corporation to the Board of Trade.

St. Martin's-in-the-Fields has passed a resolution approving of the application of the London Electric Supply Corporation with respect to the lighting of its district.

The Holborn Board of Works has decided to consent to the applications of the London, Metropolitan and House-to-House Companies.

St. George's (Southwark) Vestry has assented to the application of the House-to-House Company for a provisional order.

Ball Room Lighting.—At a ball recently given by the Royal Welsh Fusiliers at the Courthouse, Galway, to commemorate the fall of Coomassie, the Galway Electric Company lit the entire suite of rooms by incandescent lamps, including ball room, supper and refreshment rooms, entrance hall and ante room. The Courthouse was temporarily connected with the Company's central station, which is now approaching completion, and part of which is already working.

Brewery Lighting.—Messrs. Hawkes & Co., of Bishop Stortford, have determined to light up the whole of their brewery with the electric light. Messrs. Pritchett, of Stortford and London, have the work in hand.

An Electric Light Competition.—The *Daily News* Paris correspondent telegraphs :—"The Town Council of Paris offers a prize of £400 to the inventor of the most reliable system of computing the quantities of electric light used, and five other prizes of £80. If any system is only applicable to a continuous or to an alternating current, half the money offered will be given. The City of Paris will consider itself entitled to the full ownership of all the inventions which may gain prizes."

The Electric Light in the Lake District.—Steps are being taken to form an electric light company at Keswick, the project having the support of several of the most influential residents. A survey has been made, and it is expected that the works will be on the banks of the Greta, the river supplying the motive power. A prospectus will be issued to the public shortly.

Paris Exhibition Lighting.—Messrs. Crompton & Co. have secured the contract for lighting the English and American portions of the Paris Exhibition with the electric light. The contract includes the supply of 85 lamps of about 2,000 candle-power and 30 lamps of about 6,000 candle-power, and a large number of incandescent lamps. Among the other orders which the firm is now executing is one for an electric search light for the Dutch Government. It will be the biggest reflector ever made.

The Board of Works and the Electric Supply Companies.—The Metropolitan Board of Works has decided to oppose the Bill of the London Electric Supply Corporation ; but as the Board will cease to exist in April, it will devolve upon the County Council to carry out or abandon this resolution. The object of this Bill is to authorise the companies to produce and sell electricity, electric current, "and other like agency" for public and private purposes within an area comprising the parish of St. Martin's-in-the-Fields, Westminster, Chelsea, Kensington, Paddington, Marylebone, Hampstead, St. Pancras, Islington, Clerkenwell, St. George's-in-the-East, the Strand, Holborn, the City of London, Whitechapel, all the Inns of Court, Greenwich, Rotherhithe, Lambeth, Bermondsey, Southwark, and other districts in Surrey. The works which it is proposed to construct are a central station, or stations, at which electricity will be generated or collected, and a system of distributing stations and mains for the supply of electricity in the several areas defined. Among the consequential powers sought for are authority to place mains and lines required for the supply "in, through, under, over, along and across, and either above or beneath the surface, of and for that purpose to cross, open, break up, divert, alter, stop up, or otherwise interfere with, whether temporarily or permanently, all roads, streets, footpaths, and other public places, and all railways, tramways, canals, rivers, watercourses, bridges, sewers, drains, gas, water, and other pipes, telegraphic, telephonic, and electric posts, wires, and pipes, pneumatic tubes and apparatus, and works of every description, within the area of supply." The Bill likewise contains authority to cross the Thames, the Regent's Canal, and the Grand Surrey Canal, and to open or otherwise interfere with all railways and tramways running within the districts in which the company proposes to operate.

Fire at the Opera House in Buda Pesth.—On the 26th January a fire occurred during the opera through a short circuit in the leads just underneath the prompter's box ; the wires became red hot and set fire to the insulation and wood casing. Only a few days before a similar fire is said to have occurred during the performance of a ballet.

South African Cables.—The *Financial News* states that there has been no cable communication with Johannesburg during last week, the line being out of order. This interruption of communication has not only caused serious annoyance in the South African markets ; it has also led to a movement for laying a new cable. Some of the most influential men identified with the Witwatersrand district are behind it, and our contemporary learns that the capital has already been offered five times over.

Australasian Cables.—The Eastern Extension, &c., Telegraph Company notify that the laying of their new cable between Java and Western Australia is now completed, and the line will be shortly opened for traffic. This will give the Australasian Colonies the advantage of a third cable to Java, and an alternative land system *viâ* Perth to the overland line between Port Darwin and Adelaide.

Telpherage.—We understand that arrangements have just been made whereby rights in respect of the telpherage system have been entrusted under licence to the United Electrical Engineering Company, Limited. This company has issued an illustrated pamphlet giving full details as to application, construction and cost, and in the belief that telpherage is a particularly promising branch of engineering with an extensive field before it, the Company purposes making it a feature of its business. The telpherage line at Glynde has now been running satisfactorily for nearly two years, and negotiations are in progress for the erection of lines both at home and abroad, the most recent contract being for two lines in Cornwall for the carriage respectively of 1,000 and 500 tons of tin ore per week.

Sharp and Kent Instruments.—Messrs Sharp and Kent have just issued a new price list, from which it appears that they have now abolished all extra charges on their instruments, each ammeter and voltmeter being sent out with a silver dial and an enamelled scale, and the voltmeters supplied with keys. The marine type, we hear, is being largely used for omnibuses, tramcars and steam ships, and is suitable where any movement of the vehicle is likely to affect the needle.

Bombay Street, Bermondsey.—This street, though a very small one, has the distinction of being the address of two electric light firms, the Electric Sun Lamp Company, which is in liquidation, the stock being announced for sale on an early date by Messrs. Wheatley Kirk, Price & Goulty, and Messrs. A. B. Gill & Co., who are patentees and manufacturers of dynamos, motors, and switches, and who also do a prosperous business in electric lighting, one installation in which they are at present engaged in Westminster being for 1,400 lights. The latter firm is naturally anxious not to be confounded with the company whose stock is to be brought to the hammer.

Edison's Phonograph.—A very large audience assembled in the Great Hall, Tunbridge Wells, on Wednesday, the 20th February, to hear an able lecture on Edison's Phonograph, by Professor Archibald, M.A., F.R.Met.S. The theory of Edison's beautiful invention was explained in untechnical language by the lecturer, whose style is well adapted to the popularising of the perfected phonograph. Professor Archibald's eulogium of the achievements of the famous American electrician was most enthusiastically received, and the phonographic records made a profound impression upon all present. The lecture was illustrated by some excellent slides, which represented the various proposed applications of the phonograph, a view of the great inventor's laboratory, and striking portraits of Mr. Edison and Col. Gouraud.

Faure Electric Accumulator Company.—The *Financial News* understands that negotiations are pending between the liquidators of the Faure Electric Accumulator Company and the directors for a settlement of the differences between them, which recently occupied the attention of the courts. It will be remembered that the courts decided against the directors.

Institution of Electrical Engineers Students' Meeting.—A meeting was held on Friday, February 22nd, Mr. J. Rance, Jun., A.I.E.E., in the chair. The following paper was read:—"Ship Lighting and the aspects of Electrical Industries in the Colonies," by Mr. H. W. Handcock. The paper occupied the whole evening. A discussion upon it will take place on Friday, March 8th.

Transformers.—Referring to the letter of Engineer Emilio Magatti, dated March 14th, 1888, and reprinted in the REVIEW of February 1st, in which it was stated that all the underground anti-induction conductors used in Italy for central transformer installations have been manufactured by Siemens & Halske, of Berlin, Messrs. Pirelli & Co. write that while that was true at the date of the letter, there are now several anti-induction underground cables manufactured by them in the plant of Messrs. Bellani, of Turin, which have worked since last year very satisfactorily. Others are about to be laid in Rome. The insulation of these conductors is vulcanised india-rubber.

The Royal Society.—Yesterday Prof. Silvanus Thompson was to have read a paper "On the Magnetic Action of Displacement-currents in a Dielectric."

Society of Arts.—On Wednesday evening next a lecture on "Arc Lamps and their Mechanism" will be delivered by Professor Silvanus P. Thompson. Mr. W. H. Preece, F.R.S., will be in the chair.

Melbourne Exhibition.—A "First Award," equal to "Gold Medal," has been awarded at the Melbourne Exhibition to the Woodhouse and Rawson Electric Supply Company.

Electric Appliances for Police Purposes.—The new extensive head-quarters of the Metropolitan Police, now being erected on the Thames Embankment, are to be fitted with a most complete system of telegraphs, telephones, fire and police cells, electric light, and other electric appliances, both for internal and external purposes.

The Proposed Electric Railway.—Further and powerful opposition to the projected electric central subway railway is threatened. The Metropolitan Board of Works, moved by a strong petition from certain owners and tradesmen along the route from Piccadilly to Holborn Viaduct, and by the views of some of the members of the Board, have resolved to petition Parliament against the scheme. By the time the Bill comes before Parliament the Board of Works will be defunct, but they will leave this petition, together with many others, as a legacy to the County Council, and it is believed that that body will take up the matter, probably in a more active form than a mere petition.

New Steamer for the Metropolitan Fire Brigade.—On Friday last the fourth new steamer for this service ran its official trial trip, and was passed for a speed of 16 miles by Capt. Shaw, C.B. We believe there is no previous record of such high speed being attained by this type of steamer, and it exceeds that of the three other vessels designed and built by the same maker, Mr. Edward Hayes, of Stony Stratford. The vessels are steel plated, 66 feet long, 12 feet beam, 8 feet deep.

Blushing by Electricity.—A correspondent writes:—"On passing a clothier's window some days ago I was amused to see one of the *usually* lifelike and beautiful (?) boys that are engaged by tailors to exhibit their goods to admiring passers-by bearing a printed notice pinned to his chest, 'I shall blush to-night.' On enquiry of the 'knight of the shears' I found that he had a small set of storage cells in his shop and a lamp inside the waxen head of his 'dummy,' and that at intervals he switched on the light for a second or two. This having become tedious, and the blushing therefore somewhat erratic and uncertain when trade was brisk, he had requisitioned the bottle jack from the kitchen, and with an attachment from the bottom of it had made the jack do the blushing at regular intervals, without more trouble than was required in winding it up from time to time. Result—crowds round the window, and a novel advertisement."

Underground Mains.—The committee of the Boston Board of Aldermen, after visiting New York and other cities, have reported that they are of the opinion that there is no difficulty attached to the placing underground of all heavily charged wires; that the present overhead position of these wires in Boston is a source of undoubted danger; and that they recommend immediate steps should be taken for obtaining the necessary authority for ordering these heavily charged wires to be placed underground.

A New Electrometer.—A new electrometer devised by M. Curie in conjunction with M. Blondlot is made by M. Ducretet. It is a modification of the ordinary quadrant electrometer, but the needle instead of being in one piece, consists of two semi-circular segments of corrugated aluminium foil, mounted upon, and insulated from each other, by an ebonite bar to the centre of which is attached the suspending fibre. The ordinary quadrants are replaced by two semi-circular magnetised steel plates so as to introduce a damping effect and make the needle almost dead-beat. The theory of the instrument, as given by M. Curie, differs from that of the ordinary quadrant electrometer in so far as the two halves of the needle must be at different potentials, and the fixed plates which are symmetrically arranged, must also have different potentials, to obtain a deflection. Calling D the potential difference between the fixed plates, and d that between the two halves of the needle, the angle of deflection is $a = K D d$, where K is the constant of the instrument.

Electric Welding.—A company under the title of the Thomson Electric Welding Company has been formed in Boston to build and supply the electrical machinery and apparatus required for the various purposes to which the process of electric welding, invented by Prof. Elihu Thomson, can be applied. The machines now being manufactured are so graded as to apply to various kinds of work from the smallest wire to bars of over 3 inches in diameter, but the company is also prepared to supply special forms of machines adapted for heavier work, such as large forgings of locomotive frames, car axles, shafting, &c. It is also contemplated to apply the process to the welding of boiler plate and other sheet metal, and thereby replace the ordinary method of rivetting, and also to weld brass and copper tubing of large or small diameter longitudinally.

Steam Turbines.—Amongst the papers read during the recently closed fourth session of the North-East Coast Institution of Engineers and Shipbuilders was one by the Hon. C. A. Parsons, on "The Compound Steam Turbine, and its theory as applied to the working of dynamo machines."

Removal.—The Endolithic Ivory Company announces its removal to Pomona Buildings, Fore Street, E.C., adjoining Moorgate Street Station.

Thomson-Houston Electric Railway System.—The Thomson-Houston Electric Company, of Boston, which now owns the patent and other rights of the Van Depoele Company, and has secured the services of Mr. Chas. J. Van Depoele, the inventor, has issued a pamphlet describing the system, and containing reprints of important official documents on the merits of electricity as a motive power as compared with animal traction or cables, the advantages being summed up as "more rapid transit and better service, cleaner streets, smoother pavements between tracks and rails, less noise, less obstruction on crowded streets, less liability to accident, fewer repairs to tracks and pavements, the abolition of stables, and diminished cost of maintenance and operating expenses."

The Abuse of Monopolies.—We have been informed that the Edison-Swan Company has sent notices to manufacturers, dealers and users, to the effect that they are required to make an affidavit stating what number of lamps have passed through their hands up to the present time, with the object of enforcing a royalty payment of 3s. per lamp. If this correctly defines the situation we hope that there may be found in the electrical profession men with sufficient courage to resist such extortionate demands, and to fight the Edison patent again on new grounds. Such high handed proceedings can only end detrimentally to the trade and the company also in the long run. It is a question whether the shareholders of the Edison-Swan Company should not be made acquainted with the real facts connected with the incandescent lamp patent case, when the policy of the directors might be opposed and a more friendly and conciliating attitude adopted towards the electrical trades. One good thing, however, appears to have resulted from the decision in the appeal case, and that is the rising of a Phœnix from the ashes of the Old British Electric Light Company. The monopolists will understand our meaning.

English Telegraph Clerks for the Cape.—Four of the most expert telegraphists in the Leeds Post Office, named MacLeannan, Tate, Flaxington and Oddy, having accepted appointments in the Cape Telegraph Service, have been entertained by their colleagues and presented with a handsome travelling bag each, accompanied by an address of congratulation and good wishes signed by 150 fellow operators and friends. English colonies are requiring increased numbers of well-trained English telegraphists, and as they offer strong temptations, financially and otherwise, our home ranks are likely to be somewhat thinned, but happily there are plenty of candidates for vacancies.

Telegraph Cables across the Pacific.—It is anticipated that one of the main subjects of discussion at the forthcoming conference between Canada and the Australian Colonies at Sydney in the summer, will be the question of a more complete and efficient system of cable communication between these two portion of the British Empire. Many recent circumstances in connection with the Australasian cables have rendered improvements essential, and this is being emphasised by the rapid developments of steam communications and commercial relations between Australia and the Dominion.

Electric Lighting in Madrid.—With the exception of the plant in the Italian Opera House, says *Industries*, the isolated electric light installations at the Madrid theatres are going on unsatisfactorily. In consequence fresh efforts are being made to establish a large central station in this city, and it appears that there is some chance of this being now carried out, as the local authorities are giving their assistance to the scheme. Major Cabanyes, of the Artillery, is to be entrusted with the technical management of the installation, which has been promoted by Belgian capitalists. No electrical details have as yet been made known.

NEW COMPANY REGISTERED.

Great Marlow Water Company, Limited.—Capital £16,000, in £10 shares. Objects: To supply the town of Great Marlow and the parishes of Great Marlow, Little Marlow, Wooburn, Medmenhan, and Hambledon, in the county of Bucks; and the parishes of Bisham and Harley, in the county of Berks, with water, gas, and electricity. Signatories (with 5 shares each): Edwin Clark, C.E., A. Lawrence, T. H. Wright, C. Miller, R. N. Smith, Y. J. Lovell, and Lieut.-Gen. G. W. Alexander Higginson, C.B., all resident in Great Marlow and neighbourhood. Registered February 25th, without articles of association, by Arthur D. Cripps, Marlow.

Railway Automatic Electric Light Syndicate, Limited.—Capital £10,000 in £25 shares. Objects: To adopt an agreement of 14th February between D. J. Davies and John Tourtel of the first part, J. E. Spagnoletti and Joseph Crookes of the second part, and W. H. England of the third part. To acquire patents and inventions in relation to the production and supply of electric light. Signatories (with 4 shares each): *W. H. England, *G. J. Banks, F. H. Barr, J. B. Brooks, H. S. Hannam, all of Leeds; *W. Crookes, 7, Kensington Park Gardens; C. E. Spagnoletti, The Poplars, Aberdeen Place, N.W. The signatories denoted by an asterisk are the first directors. Qualification, £100 in shares. Registered 26th February by Nelson, Barr and Nelson, King's Cross Station.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Automatic Delivery Box Company, Limited.—An agreement of February 19th, filed on February 21st, between Frank Villiers Stead, E. R. Hedgman, and James Spratt, of 21, Watling Street, the vendors, of one part, and the company of the other part, states that by an indenture dated February 18th it was agreed that the vendors should sell to the company certain letters patent, No. 13,005 (A.D. 1887), relating to an electrical automatic delivery box, together with the right to take out patents for the same, for New Zealand, Victoria, Cape Colony, and India, at the price of £4,000, payable £1,600 cash and the remainder by the issue of 2,400 fully paid shares of £1 each. The present agreement provides for the issuing of the said shares.

Ward Electrical Car Company, Limited.—The statutory return of this company made up to February 15th was filed on February 21st. The nominal capital is £300,000 in £10 shares, the whole of which have been issued. 29,993 shares are considered as fully paid up, and upon the remaining seven shares the full amount has been called and paid. Registered office, 9, Warwick Street, Regent Street.

W. T. Henley's Telegraph Works Company, Limited.—The annual return of this company, made up to the 11th January, was filed on the 19th January. The nominal capital is £70,000 in £10 shares. 6,697 shares have been issued and the full amount has been called thereon. The calls paid amount to £67,240. The sum of £270 has been paid upon 90 shares forfeited.

Blakey, Emmott & Co., Limited.—The annual return of this company is made up to the 14th October. The nominal capital is £35,500 in 355 shares of £100 each. 302 shares have been taken up, 185 of these being considered fully paid. Upon 117 shares, £50 per share has been called. The calls paid amount to £5,850, and in addition the sum of £300 has been paid in advance of calls.

John Fowler & Co., Leeds, Limited.—The annual return of this company is made up to the 2nd January. The nominal capital is £680,000 divided into 50,000 preference and 18,000 ordinary shares of £10 each. 28,000 preference and the whole of the ordinary shares have been issued, the latter being considered as fully paid and the full amount has been called and paid upon the preference shares issued.

Crompton & Co., Limited.—The statutory return of this company, made up to the 13th December, was filed on the 19th December. The nominal capital is £140,000 divided into 20,000 preferred shares of £5 each and 8,000 ordinary shares of £5 each. 15,576 preference shares have been taken up, and upon 10,007 of these the full amount has been called, and upon 5,569 shares £1 10s. per share has been called. The calls paid amount to £59,020 10s., which sum includes £3,629 10s. for payments in full. The unpaid calls amount to £2,988 10s. Registered office, Mansion House Buildings, 4, Queen Victoria Street.

Electric Date and Time Stamp Company, Limited.—The registered office of this company is now situated at New Broad Street House, New Broad Street, E.C.

River Plate Electricity Company, Limited.—The registered office of this company is situated at 78, Coleman Street, E.C.

Taunton, Delmard Lane & Co., Limited.—The registered office of this company is at the Star Works, Heneage Street, Birmingham.

CITY NOTES, REPORTS, MEETINGS, &c.

The Submarine Telegraph Company, Limited.

THE half-yearly ordinary general meeting of the proprietors of this company was held on Tuesday last at the offices of the company, 2, Throgmorton Avenue, London Wall, under the presidency of the Hon. H. R. Brand.

The Secretary (Mr. S. M. Clare) having read the notice calling the meeting,

The Chairman said: Gentlemen, in moving the adoption of the report and accounts for the last half-year, I shall not detain you with any examination of them. I think they speak for themselves. They show a progressive business, and the main consideration, I think, that affects us is one of regret that we have to part with such a good business. There is one other consideration of a more satisfactory character to which I may allude. You will observe that there is a large sum of money invested in various stocks, upon which, if we take the price for the present day, there is a profit of £28,000 to £30,000. Well, now, I will give you in as few words as possible all the information in our possession respecting the arrangements with the Government for the transfer of the property of this company. It might have been supposed, and reasonably supposed, that long before this date the directors would have been in a position to give the full particulars to the company, and indeed, if this had been merely a question of the sale purchase of a business between independent corporations or between private individuals, there would have been very little difficulty or delay in settling the matter; but you must expect delay when international arrangements have to be made. At any rate, I can say that the board has not been responsible for the delay that has occurred, for they offered every facility in their power to the Government, and they acquiesced in every suggestion that the Government made, so long as they were able to do it without sacrificing the interests committed to their charge. There is one other consideration which I would ask you to bear in mind, and that is the fact that throughout the whole of these negotiations the board has not been in the position of a free agent. Their hands have been, so to speak, tied. So soon as the Governments concerned—that is to say, the English, French, and Belgian Governments—had decided to take into their own hands and to work the telegraphic system between this country and the Continent, this company lay under sentence of death, for not only all its rights, authority, and powers ceased to exist, but also—and this is the main consideration—a considerable portion of its property would have no value unless it could be transferred to those who were about to conduct the same traffic heretofore carried on by the company. That is a consideration which has always been in the minds of the directors, and they have been consequently hampered by the knowledge that it was a necessity to transfer their property over to the Governments concerned. Well, now, it was in March of last year that the company first received a definite proposal from H.M. Government. A letter was addressed to the company from the Treasury offering certain terms of purchase. Those terms were generally that the Government would take over the whole of the employés in the company's service, with the exception of seven, to whom they offered a small and, as I think, a somewhat inadequate compensation. They then proposed to take over the whole of the property of the company, that is to say, the cables, ship, stores, and the house in which you are now sitting—in fact, the whole of the property of the company, with the exception of two cables known as the Deolin and Salcombe cables. They proposed that the property should be taken over at valuation in the ordinary way, that is to say, that there should be valuers on behalf of the Government and valuers on behalf of the company appointed, and if there was any disagreement between them reference should be made to an arbitrator. The directors did not consider that in some respects the terms offered by the Government were such as they considered adequate, but in the position in which they were placed they felt that they had no option but to accept the terms thus offered. But they urged the Government to reconsider their decision as to the Deolin and Salcombe cables, and I may say that from personal assurances which I have received at interviews I have had with the financial secretary on behalf of the board, in the chairman's absence, I feel confident that the Government will relieve us of any difficulty with regard to these two cables. This offer of the Government was made subject to conditions, and those conditions were that the assent of the other Governments concerned should be obtained, in so far as the interests of those Governments were concerned. That was the condition in which matters stood until a very recent date, when we received this information from H.M.'s Government, that they were under a convention with the French Government either to purchase cables or to lay down cables jointly, and that the French Government and the Belgian Government had not seen their way to accept the principle of arbitration. Under these circumstances the question arose, what was the course the company should take? I would refer you again to the remarks I made as to the position in which the company was placed. It was obvious, although we considered that it would have been much more to the interests of the company that the French Government should have accepted arbitration, yet under the circumstances we were compelled to accept the alternative proposal made by the French Government. That Government, having refused arbitration, proposed the alternative course of action—that there should be an independent valuation of the cables made by the officials of the French, Belgian, and English Governments, and that they should have access to the books of the company, and having examined those books and tested the cables, they should offer the company a price for the cables which the company could either take or leave. The board certainly consider that that course is a somewhat arbitrary one, and one which might lead to most inequitable results, but they felt that they had no option but to accept the proposal. It is very difficult to estimate what will be the result of this valuation, but we have received the most positive assurances from both the English and French Governments that they wish to deal with the company in a spirit of equity, and, for my part, I am inclined to place more confidence in this assurance, because it is impossible to believe that these great and powerful Governments should wish to take the property of this company in any other spirit than that of equity to those who are not only shareholders in this company, but who are citizens of either England or France, and may well look to their respective Governments to protect their interests. That, so far, is the state of the case at the present moment. I have nothing to add to what I have said, except to express a hope that very shortly—in a week or so—these arrangements will be completed, and that the whole thing will be settled by the 31st of March. If, and as soon as, they are completed, you will be called together to sanction them. At that time Sir Julian Goldsmid, who is absent on the Continent on business, will attend personally. Having given all the information which I have at present in my possession, I beg to move the adoption of the report and accounts.

The Hon. Ashley Ponsonby seconded the motion.

Mr. Soden condemned the arbitrary action of the Government in influencing the French Government to refuse a renewal of the company's concession. It was simply an act of confiscation.

The Chairman, in reply, said that the directors could not have acted otherwise than they did. It would have been an act of suicidal folly to take up a position antagonistic to the Governments. It was not a revocation of the company's licence. They had come to the end of the concession, and the Governments said, "We are willing to pay you a fair value for your property. You have had all these years of great profits, and now you come to the end of your life, and we are willing to give you a fair value for your property. If you do not choose to take it you must risk getting nothing for it." The board felt that they would not have been acting in the interests of the shareholders if they had not taken care to give no excuse to the Governments for laying down cables for themselves. The shareholders, however, might rest assured that the board left no stone unturned to get the best possible terms for the company.

The resolution was carried unanimously.

The Chairman then proposed, and the Hon. Gathorne Hardy seconded the declaration of the dividend recommended, namely, at the rate of 16 per cent. per annum, free of income tax, payable on and after the 1st March next.

Mr. Soden proposed a vote of thanks to the Chairman and directors, and the Chairman having briefly returned thanks, the proceedings terminated.

Telegraph Construction and Maintenance Company, Limited.

THE twenty-fifth ordinary general meeting of this company was held at the offices, 38, Old Broad Street, E.C., on Tuesday, Mr. Philip Rawson presiding.

The notice convening the meeting having been read,

The Chairman, in moving the adoption of the report (which was published in the REVIEW last week), first expressed his regret at the absence of Sir Daniel Gooch, chairman of the company, who was suffering from bronchitis. The accounts did not enter largely into details, and it would be very unwise in such a company as theirs to do so. They were still enabled to recommend a dividend of 20 per cent. for the year. During the past year the factories both at Greenwich and at the gutta-percha works at Wharf Road had done a considerable amount of work. About 6,000 miles of telegraph wire had been insulated, including submarine and land lines. Their steamers had repaired the Brasilian Submarine cable in January and August, the German Union cable, and the Heligoland cable. The *Scotia* was also employed for three months in repairing the Direct United States cable. A line was also laid of about 456 miles connecting the Dutch Settlements with Java and Macassar, and the steamer afterwards left this country to connect Java with Western Australia by a cable about 1,000 miles long. That cable had been successfully laid, making now the third line to Australia. A further contract had been entered into for connecting the West African system with the Cape, and the length of cable required was 1,350 miles. The greater part of the cable was manufactured this year, and the vessel would sail with it at the end of this week. This cable commenced from a place called Massamades, a Portuguese settlement on the West Coast of Africa, and it would when completed be laid to Cape Town. Africa would then be surrounded on all sides by cables. The steamship *Kangaroo*, which was chartered by the Italian Government for distilling water in the Red Sea, had been returned to the company, and had since been sold. Their steamship *Calabria* had been chartered from them on very good terms to make a large number of voyages between Antwerp and the River Plate for emigration purposes. The company's works at Greenwich and Wharf Road were in excellent working order. To fill the vacancy at the board caused by the death of Lord Alfred Paget, who assisted them for 18 years, they had appointed Mr. William Shuter, who had been connected with the company from the beginning. The £150,000 of debentures bearing 6 per cent. had been renewed at 5 per cent. Passing to the balance sheet, he stated that the debts owing to the company were perfectly good, and the sundry securities, which figured at the close of the year for £468,641, represented securities which, perhaps, were a little more valuable than the amount stated. The net profit on the year's working was £82,580. He concluded by moving the adoption of the report and the payment of a dividend of £1 16s. per share, making with the interim dividend £2.8s. per share, or 20 per cent. for the year.

Mr. Geo. W. Campbell seconded the motion, which was carried unanimously.

The retiring directors and the auditors were re-appointed, and the meeting terminated with the usual vote of thanks to the chairman.

Electric Date and Time Stamp Company, Limited.

THE Electric Date and Time Stamp Company, Limited, has been formed with a capital of £100,000, in shares of £1 each, of which 13,000 will be issued as fully paid to the vendors in part payment of the purchase consideration. The present issue offered for public subscription is 27,000 shares. The company has been formed for the purpose of acquiring and working all rights for the United Kingdom in the patent granted to Charles Adams Randall in respect of the Electric Date and Time Stamp, an apparatus in which are conjoined a clock, an electric battery, and a stamp. In the stamp there are type wheels, with connecting gear disposed on a single axis, and the minute, the hour, and the day, the month, and the year are correctly placed in line under the impression pad. The minute wheel is actuated by an electric current from a battery transmitted through the medium of a circuit closer attached to any clock. At the 60th movement of the minute wheel, the hour wheel is moved automatically, and similarly at the 24th movement of the hour wheel —at midnight—the day wheel, thus changing the date. The machine works automatically, and, according to the prospectus, is not liable to get out of order. It is stated that the company has already received an order for the instrument from the General Post Office and a large number of banks. It is proposed to let out the machines at a rental of two guineas per annum.

Lancashire and Cheshire Telephonic Exchange Company, Limited.—The accounts made up to the 31st December last show a gross annual revenue of £98,957 12s. 8d., as compared with £91,925 17s. at the same period of previous year; and, at a meeting of the directors held this week, it was resolved to declare an interim dividend for the half year ended 31st December, 1888, at the rate of 7 per cent. per annum, being at the same rate as for the corresponding period of 1887. The unaccrued revenue, carried forward to the credit of next account, amounts to £33,537 12s. 7d., as against £31,369 7s. 2d. in 1887. At the present time the company has 4,350 "exchange" subscribers, 1,490 private lines, 9,500 miles of wire (including 2,750 for communication between towns), and a gross increase of over £100,000.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 22nd, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £4,884.

CITY ELECTRIC LIGHTING.

SPECIAL MEETING OF THE COMMISSION OF SEWERS.

ON Tuesday a special meeting of the Commission of Sewers was held at the Guildhall, in consequence of a requisition by certain members, to consider the report of the Streets Committee on the subject of electric lighting, submitting draft conditions, with a view to advertising for tenders. Mr. G. MANNERS (the chairman) presided.

Mr. BRIDGMAN, in moving the adoption of the report, said the matter of lighting the City by electricity was of very great importance to the citizens, and one which would have an important bearing on the question of lighting by electricity generally. Several references and communications had been made to the Streets Committee on this subject. The first step they took was to refer the matter to the engineer and solicitor, with instructions to confer with Mr. Preece upon the Electric Lighting Act of 1888, and then to prepare and submit to the committee the conditions on which the proposals for lighting the City by electricity could be entertained. On receiving that report the committee proceeded to consider four primary recommendations. The first was that it should be obligatory on the companies with whom contracts may be entered into to lay all wires and conductors beneath the public way. They thought the time had come when they should discountenance any more wires being placed overhead. The second recommendation was that the City should be divided into three districts, in accordance with the plan prepared by the engineer and Mr. Preece, and alternative tenders be invited for lighting the said districts and the City as a whole. The third was that the main streets be primarily lighted, and be enumerated in the specification; and the companies proposing to contract be required to state the period at which the lighting of such thoroughfares will commence, and when it will be extended to the remaining streets. The fourth was that it be a condition of any contract that when the profits have reached a cumulative dividend of 10 per cent. the surplus be divided equally between the contracting company and the consumers. Those conditions were referred back to the officers to be embodied in a general specification of conditions. These were again carefully considered seriatim, and altered as required, and subsequently approved by the committee, and then presented to this Court. The report has been circulated amongst the members of the Court for their perusal, and the committee now asked the Court to approve of their recommendation, and refer the matter back for them to obtain tenders. They intended to light the whole of the City by electricity, but, of course, the commissioners would reserve to themselves the right of accepting or rejecting any tenders submitted. The City would be divided into three districts—western, central, and eastern. The first line of division would go down Aldersgate Street, St. Martin's-le-Grand, St. Paul's Churchyard (north side), Creed Lane, and St. Andrew's Hill, and thence along Queen Victoria Street to Blackfriars Bridge. On the south by the Victoria Embankment, and on the west by the City boundary. The central district will comprise the area bounded on the north by the City boundary, on the east by Finsbury Pavement, Moorgate Street, Princes Street, thence across Mansion House Street, along Walbrook and Dowgate Hill. On the south by the river Thames, and on the west by part of Upper Thames Street, St. Andrew's Hill, Creed Lane, St. Paul's Churchyard (north side), St. Martin's-le-Grand, and Aldersgate Street. The east district was bounded on the north and east sides by the City boundary, on the south side by the river Thames, and on the west side by Dowgate Hill, Walbrook, Princes Street, Moorgate Street, and Finsbury Pavement. With regard to the tenders, it was proposed that an Ordnance map should be submitted, upon which should be shown the whole of the lamps as they at present existed, and also the different positions for the arc and glow lamps. A description of the lamps to be used would be given, and also a diagram showing the intensity of light. The standard of reference will be the illumination of a square foot of surface by a standard candle at 12·7 inches distance. So soon as the main thoroughfares have been lighted by electricity the contractor must proceed to light the remainder of the public ways when called upon to do so. The present arrangement of gas lamps would continue precisely as it was, in case of a breakdown of the electric system, in which case gas would be immediately available. Any excess of electricity would be paid for *pro rata*, according to contract. The work, of course, would be done under the supervision of the engineer entirely. Subways would be made where they were suitable for the purpose, and where they did not exist the whole of the lines will be put beneath the footways. A fine of £1,000 would be imposed in the event of the contract not being fulfilled in the case of each of the three districts. It was proposed to give the contractors the exclusive right of lighting the City for private purposes, as far as it could be given. The words of the report were:—"So far as the Commissioners are able to do so they will grant to the contractor the exclusive right of supplying electricity for private purposes within the district during the term of the contract. The contractor will be required to supply electricity to any owner or occupier of any premises within a distance of 25 yards of the mains, provided the owner or occupier enters into a fair agreement to defray or divide the cost of the service main, and to pay for the supply of the electricity. The contractor will have to state how he proposes to charge the consumer for the amount of electricity supplied, whether (1) by meter or (2) by agreement. (1) If by meter, the charge will be either by the actual quantity of energy supplied as measured in 'units'—each unit being equivalent to 1,000 watts per hour; or by the mean average current expressed in ampères per hour multiplied by the number of hours of supply. (2) If by agreement, the charge will be at the rate of so much per annum per standard lamp of 50 watts." The contractors would have the right of continuing private lighting, though the public lighting might be discontinued, provided they had fulfilled their contract. A fine of £20 a day would be enforced for any defect of any of the mains or conductors of electricity, and a further fine of 40s. would be enforced for every delay of five minutes in lighting any particular lamp. All responsibility for this would rest with the contractors. If the profits arising from the investment exceeded a cumulative dividend of 10 per cent. per annum upon the capital invested, the excess was to be equally divided between the contractor and the consumer. The duration of the contract would be for 21 years, but the Commission would have the power to continue it for periods of seven years. They would also have power to determine a contract after three attempts to make good a failure. Power would be reserved to the Commissioners to acquire the undertaking by purchase at the end of 21 years. Mr. Bridgman then pointed out the difference between these conditions and those of last year. On the previous occasion option was given to the contractors to lay the wires underground or overhead.

Mr. King : The Brush Company had no such option.

Mr. Bridgman : Well, he might be wrong in that respect, but certainly there was no control as to the regulation of dividends and profits, and there was no provision, as now, for acquiring the interests of electric lighting companies. The contract was then for seven years only. They were much more likely to get tenders for 21 years, considering the large amount to be expended. Mr. Pannell, amongst others, was last year strongly opposed to the report. He would tell them the present conditions were as favourable as they could be to the commission, while they had also thought of the contractors. Mr. Harris seemed to have a strong preference for lighting by gas—("No")—but since the last attempt they had gained a considerable amount of experience, and Mr. Preece had told the committee that the time had arrived when the City might confidently adopt the system of lighting by electricity, and certainly an improvement was much needed in the mode of lighting our City streets, which was not worthy of the centre of our great Empire.

Mr. C. T. Harris moved an amendment, "That the report be received and consideration adjourned pending the applications to the Board of Trade for Provisional Orders authorising the London Electric Supply Corporation, Limited, and the Metropolitan Electric Supply Company, Limited, to supply electricity within the whole of the City of London. He said if there was one thing more than another about which the Commission should exercise the utmost degree of caution it was electric lighting. Costly experiments had taken place during the last few years which had invariably been attended by disaster and failure. In the past the Commission had been made a catspaw of speculative companies, who had paid 100 per cent. dividend. The present report was utterly different from the last, and he was pleased to hear the chairman utterly condemn the report which he last year seconded. If this one was feasible, the one last year must have been very bad indeed. He opposed the report last year because it gave a monopoly of private lighting, without any stipulations as to the price to be charged and as to profits. He objected to contracting with any companies outside the Act of Parliament. They would give the companies the advantage of statutory rights, but free them from statutory obligations. They proposed to give a monopoly of private lighting for 21 years. He did not hesitate to say they had no legal power to do any such thing. All they could do was to promise to oppose any other company that might wish to come into the City. They had at the present time substantial companies applying to Parliament for statutory powers. One had a capital of a quarter of a million and another of half a million, and during the present session their applications would be decided. He was surprised to see in the *City Press** of last Saturday a report of Mr. Preece to the Streets Committee. Two-thirds of the Commission were not aware of its existence, and would never have known of it but by reading it in the *City Press*. He found that it was the substance of a private and confidential communication to the Streets Committee, every page of which was marked in red ink, "private and confidential, for the use of members only." He thought the Commission should be better acquainted how these things got about. It was intended to prejudice the question. Mr. Preece suggested for the careful consideration of the committee the undesirability of throwing this work open to public tender. This was just what the Commission proposed to do. Mr. Preece said the only three companies, as far as he knew, in a position to supply the current to the City were the Anglo-American Brush Company, the London Electric Supply Corporation, and the Metropolitan Electric Supply Company. It was clear these companies could not make any contract with them until Parliament had considered their application. ("Nonsense!") How could a company contract to make a provision for private lighting different from that which the Board of Trade might impose? The *City Press* said if his amendment were adopted it would delay the electric lighting of the City two years at least. The Court, however, had already determined to oppose the application for Provisional Orders for the purpose of obtaining a *locus standi*. Let them in the meantime use this as a leverage. If they proceeded at once they would be led into costly litigation. He wanted the electric light brought to the doors of everyone at the smallest possible price, and they could only do that under cover of such companies as were now applying for statutory powers. The engineer would tell them that the arc light was not suited to the lighting of the City. They did not want large lights at great distances apart, but lights of small intensity at frequent intervals. Incandescent light for indoor purposes had undoubted advantages, but it cost three or four times as much as gas. It was the light of luxury.

Mr. S. Harris seconded the amendment.

Mr. J. C. Bell deprecated as much as Mr. Harris, the fact that documents should appear in public prints before they came to the Commission. At the same time he agreed in the main when they stated there was something far more behind this amendment than appeared on the surface. Mr. Harris seemed to speak as the advocate of the gas companies. All Mr. Preece had said was that, in his opinion there were only three companies financially capable of carrying out this work. This was not the time to discuss the details of the contract, and the pros and cons of electric lighting. They were not bound to accept any of the tenders, and could, if they liked, revert to the old condition of things. Mr. Harris had excluded one of the three companies mentioned by Mr. Preece.

Mr. Rose-Innes asked the solicitor if it was a fact that they could not contract with companies who were applying for provisional orders, except by means of a provisional order.

Mr. Baylis (the solicitor): Of course there is no doubt we can.

Mr. C. T. Harris : I said they would not.

Mr. S. Price did not see why the committee's report should not be adopted, but he cautioned the Commission against giving a fancy price for the article. The electric light would be the light of the future, but it was not the light of the present. The only people who had made anything out of electric lighting up to the present time were promoters of companies, who had obtained millions out of the British public.

Mr. Deputy Bedford said they had been adjourning this question for about five years, and now Mr. Harris wanted it adjourned again. If it was a question of Harris versus Preece, he should prefer Preece. They were becoming the laughing stock of the whole country. With regard to lighting he meant. They had just the same glimmer as five or ten years ago.

Mr. Greenwood said in all the towns he had seen lighted by electricity they had to supplement it with gas. At Eastbourne these was a gas light between each of the electric lights. It was the same at Hastings and St. Leonards. At Barnet on two or three occasions the place was left in darkness; and at a lighthouse four engines had to be employed.

Mr. Stapley said the all-important question was the one of time. It was shown that they were in a better position now for having waited twelve months. Might they not be in a better position still if they waited until statutory powers were obtained, and worked under those powers? Otherwise they might be put to great legal expense.

Mr. Innes, referring to a quotation from the *Times*, said they preferred governing themselves, and having as little Government interference as possible. They did not wish to place themselves under Parliamentary control. Suppose the control gave 42 years instead of 21 years.

Mr. C. T. Harris : But no monopoly.

Mr. Innes : Mr. Harris was only interested in one monopoly. The Constitutional Club, the Hotel Metropole, and the Avenue Theatre had the electric light, and he had not heard of them going back. The electric light cost them more, but they had only to do the place up once in two years instead of every three months. This would be so in City houses, and the insurance would also be affected. If it turned out too expensive or unsuccessful they would have an answer; if, on the other hand, it suited their convenience, let them take it.

Mr. Cloudesley held that in the Post Office here and at Glasgow the electric light was being used without gas as an auxiliary. They could not compare the City with Eastbourne or Barnet.

Mr. Wood would much have liked to see Mr. Preece's report, and he suggested that as Mr. Preece was present he should inform the Court what was the probability of success in the event of their getting suitable tenders.

The **Chairman** asked if the Court would like to hear Mr. Preece. (Cries of "No!")

The amendment was then negatived.

Mr. Deputy **Ashby** moved a further amendment to omit the word "exclusive" in the following clause:—"So far as the Commissioners are able to do so they will grant to the contractor the exclusive right of supplying electricity for private purposes within the district during the term of the contract." He strongly objected to giving any company an exclusive right. The gas company already had a monopoly, and they did not want another one.

Mr. Treloar seconded the amendment. He said if any tradesman in the City chose to put up the electric light for his own use he could not supply his neighbour with it.

Mr. Pannell said they did not want to give half a dozen people the right of opening up the streets.

Mr. J. C. Bell said no contractor would spend £80,000 for the benefit of the Commission. He must have some kind of return.

After some further discussion, the amendment was rejected by 20 to 19.

The report was then agreed to *nem. con.*, and the Commission adjourned.

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* This report was published in the Review some weeks since.—Eds. Elec. Rev.

COMPOUND-WINDING PATENTS.

KING, BROWN & CO. *v.* ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION.

(*Continued from page 740, Vol. XXIII.*)

THERE has now been lodged in the Court of Session, Edinburgh, the evidence of Mr. Charles F. Brush, taken on Commission in America, in connection with the action at the instance of King, Brown & Co., Rosebank Electric Works, Broughton Road, Edinburgh, against the Anglo-American Brush Electric Light Corporation, Limited, 6, York Place, Edinburgh, for reduction of letters patent granted in October, 1878, for improvements in apparatus for the generation and application of electricity for lighting, plating, and other purposes. It will be remembered that evidence was taken in the case before Lord Trayner in December last.

The examination of Charles Francis Brush, of Cleveland, Ohio, in behalf of the defenders was taken at the office of the clerk of the Circuit Court of the United States for the northern district of Ohio before Mr. Augustus J. Ricks, commissioner. The examination was begun on the 24th December. There were present, on behalf of the pursuer, Mr. Henry S. Sherman, of the firm of Sherman and Hoyt, solicitors for the pursuers; and on behalf of the defender, Mr. L. L. Leggett.

Mr. BRUSH stated that he had no personal knowledge of the pursuers. He had been acquainted with the defender's company since its organisation as a corporation. He was the person referred to as Charles Brush in Brush letters patent, No. 2,003, of 1878. He claimed and believed himself to be the first inventor of the invention therein described and claimed, and he did communicate it to Herbert John Haddan. To the best of his knowledge and belief such an invention, so far as claimed in the disclaimed patent 2,003, of 1878, was novel in the United Kingdom at that date. At that time dynamo-electric machines were used principally for two purposes—electric plating and electric lighting by means of the arc system. Prior to the date of his invention here in controversy it was customary to construct dynamo-electric machines for both, and for the purposes above specified on what was known as the series plan. In this arrangement the field magnet coils of the machine are placed in series with the armature circuit and external working circuit of the machine. Some of the earlier plating machines (he did not refer to his own) had their field magnets excited by a separate magneto-electric machine. He had in mind the old Wilde machine. The shunt dynamo was not known then so far as he knew. The state of knowledge as to the construction of incandescence lamps was exceedingly crude at that time, and no incandescence lamp of a practical or commercial nature had been produced. In his opinion no one inventor could be given the credit alone of having made it possible to construct incandescence electric lamps of a uniform resistance. If he was correct the ability to accomplish this was the result of a more or less gradual development and evolution at the hands of more than one inventor.

In what way were the dynamos then in use unsuited for lighting in parallel?—As I understand this question, you ask in what way were dynamo-electric machines known or used prior to my invention here in controversy unsuited for incandescence lighting in parallel arc. With this understanding my answer is that these prior dynamos to which you refer were unsuited for the purpose named because of their inability to maintain a substantially or sufficiently constant potential or electromotive force with varying amounts of work in their external circuits. They could not operate normally a small amount of work as well as a large amount of work in their external or working circuits.

What was the object of your invention?—The object of my invention was the production of a dynamo-electric machine that would automatically maintain a substantially or sufficiently constant potential under varying amounts of work in its external or working circuit. In other words, a dynamo that should be adapted automatically to operate normally a small quantity of work as well as a large quantity in its external circuit. While in my specification I have fully described the suitability of my dynamo for operating electroplating baths, I did not in any degree intend to limit it to such a use, and in this connection I will quote from the specification of the Haddan patent, as amended and disclaimed, commencing on line 19, page 11, which reads as follows:—"It will now be obvious that if even a moderately strong magnetic field be constantly maintained within the machine, both of the above described difficulties will be eliminated. Other useful applications of a permanent field machine will readily suggest themselves." It was entirely apparent to me that my dynamo was eminently suitable for other uses than that of electroplating, and in my language above quoted I designed to state the fact.

In what way is your invention of value with respect to incandescent lighting?—Mainly in the particulars already indicated. My dynamo is of great value for incandescence lighting, because of its ability to maintain automatically a substantially and sufficiently constant electromotive force, and to automatically and normally do varying amounts of work, from great to small, upon its external or working circuit. To successfully do this a constant potential dynamo-electric machine, such as my patent describes, and such as I successfully produced for the first time, as I believe, is necessary.

When did a demand for machines with constant electromotive force first spring up?—The want of such machines was felt prior to my invention here in controversy, and it was the recognition of this want that led me to produce said invention. Promptly after, and continuously since the production of my constant potential dynamo, there has been an active demand for such machines. Therefore, while we may say that the want of this type of dynamos existed prior to my invention thereof, and was the impelling cause which induced me to enter this particular field of invention, the active commercial demand for constant potential dynamos could hardly be said to precede their existence. I should say, then, that a demand for dynamos with constant electromotive force first sprang up promply after my invention, enabling the want of such a machine to be satisfied as it did.

When did you begin to make machines according to your specification?—In the latter part of 1876, or early in 1877, and continuously since that time the Brush Electric Company of Cleveland, Ohio, have supplied the market demand for such machines.

Did you make any tests of these machines made by you? Have you any data or correspondence relating to those tests? If so, produce them?—I did make tests of these machines, and I have correct memorandum data of them. On August 4th, 1882, I sent a letter to Mr. Swinburne containing definite reports and data of tests made prior to that date. The original of that letter is not now in my possession, as I surrendered it for use as an exhibit in the record of a suit in the English Courts brought by the Anglo-American Brush Electric Corporation, Limited, against R. E. Crompton & Co., but I have a correct copy of the letter. This letter was dated Cleveland, Ohio, August 4th, 1882, and read as follows: "Mr. Swinburne, Dear Sir,—I enclose memoranda of measurements of the three dynamo machines ordered by you. Intended to send you these data long ago, but forgot to do so. I made the measurements myself, and although the work was very hurriedly done, I have no doubt the results are very nearly correct. The speeds noted are what the machines happened to have when the measurements of current were made. The E.M.F. will, within reasonable limits, vary directly as the speed, and from the enclosed data, you can easily calculate what speed is required for any particular E.M.F. The E.M.F. given is measured at the binding posts, and hence it is all available for external use. The uniformity of E.M.F. with widely varying current is quite remarkable, and is greater than I had expected to obtain. You will notice that after a nearly maximum current is reached, the E.M.F. falls off rapidly. The reason for this is obvious. On a short circuit scarcely any current is developed. As the current increases, the brushes must be moved forward in the direction of rotation of the commutator, and *vice versâ*. If when the brushes are far forward (large current), the working circuit is opened, or its resistance greatly increased, very destructive sparks appear on the commutator, and the brushes must at once be thrown back, until he sparks entirely disappear. The brushes must be placed tangential to the commutator at a point ⅛th or ¼th inch from their ends, so that the sides and not the ends of the brushes touch. This is essential. Of course you cannot overwork the machine. It automatically protects itself. Respectfully yours, C. F. Brush."

Since the time you began to make said machines have you or the Brush Electric Company of America supplied compound wound dynamos, and if so, how many, and for what purposes?—Since the time when the Brush Electric Company began making these machines for electro-plating purposes in 1876 or 1877 they have continuously supplied the market demands for them. I cannot here state the precise number of such of my dynamos as have been sold up to the present time, but can conservatively state that the number reaches many hundreds. The principal uses to which these machines have been put are those of electro plating, electric lighting, the running of electric motors, and the operation of electrical furnaces for the reduction of highly refractory ores.

Describe the action of your two coils?—Understanding your question to refer to two field circuits of my "compound wound" dynamos, I will answer that the action of the main or coarser wire field circuit is the same as the field circuit of a "series field" self-exciting dynamo. If the field magnets were provided only with this circuit no magnetic field would be maintained when the external circuit was opened excepting that due to residual magnetism, and the machine in that condition would develope a very feeble electromotive force. The second or shunt circuit I therefore apply to the field magnets for the purpose of constantly maintaining a magnetic field and consequently an available electromotive force in the machine, no matter what the variations of electrical resistance in the external or working circuit, or whether that circuit is closed or open. This second or shunt field circuit is so coupled up that it is constantly closed and therefore always active and effective during the operation of the dynamo. In the dynamo having only a "series field," the excitation of the magnets varies directly with the current produced by the machine, and consequently the electromotive force rises as the current increases. In the shunt wound dynamo the excitation of the field magnets varies with the electromotive force of the machine, which latter varies in the inverse sense with the current produced. Hence an increase of current directly causes a decrease of electromotive force, which decrease is necessarily aggravated by the accompanying decrease of field excitation. It will thus be seen that the falling off in electromotive force of a "shunt wound" dynamo as the current increases is not self-correcting, but is self-aggravating. The "series shunt" machine is a combination of the foregoing two. The two coils obviously are mutually corrective in their action as regards the tendency of either coil alone to produce varying electromotive force.

The proceedings were then adjourned.

On resuming on January 25th, 1889, Mr. Brush's examination was continued.

Can a shunt or a series-wound dynamo be used in the same way with the same effect, and why not?—No; in my answer to interrogatory 16, I have explained why not.

Do you show in your specifications both the long and the short shunt?—Fig. 1 of the drawings of my patent illustrates what is now known as the long shunt series winding. This is the arrangement of series winding wherein the current traversing the shunt winding must also traverse the series winding. The benefit of this arrangement may be illustrated by tracing the path of the current in the machine when the external circuit between the binding posts is open. Under these circumstances the current may pass from the commutator brush, C, and binding post, D′, through the shunt, E E E, and then through the metal of the binding post, D, connect with one end of the series coil, F, through which coil the current further passes and finally reaches the commutator brush, C′. By this arrangement the shunt circuit consists not only of the coils of fine wire, E, but also of the coils of coarse wire, F, thus increasing the efficiency of this part of the device. In the arrangement shown in fig. 2, the shunt current, starting from the binding post, D, which is electrically connected to the brush, C, as shown in fig. 1, after passing through the shunt coil, E E, reaches the commutator brush, C′, and from thence through the commutator of the machine returns upon itself without passing through the series coil, F.

Explain the words permanent field in the specification.—The words permanent field, in line 22, page 11, of the Haddan specification, as finally amended and disclaimed, refer to the permanent field of the machine, which exists both with the shunt field arrangement and with the series shunt field. These words do not mean unvarying field, as is explained further on in lines 38, 39, 40 and 41 of page 11, but they mean permanent field of unvarying polarity.

How are dynamos now made which are used for lighting in parallel?—I make them on the shunt series or compound-winding plan, which I have already described.

Are the requirements for electro-plating analogous to those of incandescent lighting in parallel?—They are. The conditions which obtain in electro-plating as I have described it in the Haddan patent, and in the operation of incandescence lamps as ordinarily practised, are identical so far as the desirability and utility of constant potential dynamo-electric machines is concerned.

Are the directions in the specification sufficient to enable a workman to make the invention the subject matter of the patent?—I believe that the directions in the specification describing my invention are abundantly sufficient to enable any workman reasonably skilled in the art to which this invention appertains at the date of the Haddan patent to have made and practised said invention without the exercise of anything more than ordinary mechanical ingenuity on his part.

Now turning to Varley, No. 4,905 of 1876, have you read it, and do you find therein compound winding, such as is claimed in Haddan's specification 2,003, of 1878, disclosed there?—I have carefully examined Varley's patent, No. 4,905 of 1876, referred to in the question, and I do not find disclosed therein anything which at the date of the Varley patent would suggest to a skilled workman the arrangement and connection of field coils now known as compound winding, and specifically shown and described in the Haddan patent.

Refer especially to page 3, lines 38 to 49, third edition. Is such part a correct or intelligible description of compound windings?—I have referred particularly to that part of the Varley patent required by the question, and have studied this part of the specification carefully, both by itself and in connection with the drawings, and in connection with an earlier English patent to the same inventor, alluded to in the early part of the specification, of which the same lines form a part, and I must say that the section of this Varley patent referred to is not a correct or intelligible description or disclosure of compound winding. The part of the specification referred to in the question is to me exceedingly vague as well as ambiguous. I can suggest several theories as to what the writer intended by the language used; but, as I have said before, the matter is to me so vague in its nature that none of these theories is to me satisfactory. In lines 38, 39, and 40, of page 8, referred to in the question, the writer says: "Part of the electricity developed by the machine is diverted to maintain" the magnetism of the soft iron magnets, and the "remaining portion is used to produce the electric" light. There are several well known ways of doing "this." The only well known way, so far as I am aware, at the date of the said Varley patent of energising the field magnets of a machine, aside from the use of a separate and independent current for this purpose, was by putting them directly into the circuit of the armature and external work. The writer in the lines I have quoted may have intended to express the idea that a part of the electrical energy developed by the machine was used to maintain the magnetism of the field magnets, while the remaining portion of the electrical energy was used to do external work—that is, to operate an electric light. But this theory of the meaning of the lines is not compatible with other portions of the specifications. In the three lines which I have quoted the writer may have had in mind what is known as a shunt "winding" of the field magnets, but he has shown no such arrangements in the drawings. In lines 40, 41, 42, and 43 the writer says:—"But the method I prefer is to wrap the soft iron magnets with two insulated wires, one having a larger resistance than the other. The circuit of larger resistance is always closed, and the circuit of less resistance is used for the electric light." In the light of our advanced knowledge of dynamo-electric machinery at the present date, these words might be said to hint at what is known as a "series shunt winding." But considered in the light of the state of the art which obtained at the time of Varley's specification, they might mean this or several other things. The lines taken in connection with the drawing thereof certainly do not describe with even a tolerable amount of clearness "series shunt winding." In fact the drawings in no case show anything approaching such an arrangement, but show simply—and I may add, show this clearly—a series winding. The specification states that the writer's invention consists in an improvement on an invention for which he obtained a patent, No. 1,755, dated June 1867, and he states on page 7, beginning with line 1: "My improvement consists in separating 'the development of the electrical and magnetic forces' to a considerable extent, obtaining thereby a greatly increased magnetic potential in the bobbins, which, at a later stage, becomes converted into electricity of a correspondingly high potential." This has nothing to do with the winding of the field magnets of the machine, and hence we may assume that so far as the winding is concerned the machine is intended to be substantially like that described in the Varley patent of 1867. In this patent, page 7, beginning in line 19, the writer says: "When we use four electro-magnets we employ two commutators and four bobbins. Two of these bobbins and one commutator are arranged on the axle at right angles to the other bobbins and commutator, and electro-magnets are wrapped with a double series or convolutions of silk or cotton-covered wire, insulated one from the other. One set of convolutions of insulated wire of the four pairs of electro magnets is connected to one commutator and the other set is connected to the other commutator." The writer here evidently has in view a double series machine; it is a machine producing from one armature two distinct currents, each having its own commutator and each current energising a separate set of field coils on the magnets. He also states that "two of the bobbins and one commutator are arranged on the axle at right angles to the other bobbin and commutator." The reason for this arrangement is sufficiently obvious. Each pair of bobbins produced what is known as an alternating current, the alternations of which being corrected by the commutator produced a pulsating current; that is, a current consisting of waves or pulsations rising from nothing to a maximum, and quickly dropping to nothing again, and so on. Such pulsating current is not well adapted to energise field magnets, because the magnets partially demagnetised themselves between the current pulsations. Now, by means of the arrangement of the two pairs of bobbins at right angles with each other, the maximum strength of each pulsation of one of the currents produced by the machine will occur at a point of time between the corresponding periods of the other current, and will thus, so far as the excitation of the field magnets is concerned, bridge over the gap, so to speak, in the other pulsating current, and render the resultant magnetising effect of the two currents more nearly uniform than would be possible with either current separately. Referring again to lines 40, 41, 42 and 43, page 8 of the Varley 1876 patent, referred to in the question, it seems to me that a possible explanation of the language therein, when taken in connection with that of the earlier patent to which I have called attention, may be that the writer of the lines intended to secure a machine with its commutators and armature bobbins so arranged as to produce two separate and independent currents, one of which was caused to flow through the magnet circuit of low resistance and the arc lamp external to the machine, and the other of which was caused to flow through the magnet circuit of higher resistance, and the helices of the lamp motor external to the machine. After describing the construction and mode of operation of his electric lamp, in which is employed an electric motor, the writer says (page 9, lines 21, 22, and 23): "The insulated wires composing the helices (referring to the helices of the lamp motor) is connected to the insulated wire surrounding the soft iron magnets of the machine, and usually inserted in the circuit of greater resistance." My last enunciated theory of the meaning of the lines referred to in the question, while to me the most plausible of any I have advanced, is not satisfactory to me, because it supposes a foolish and complicated arrangement, and because the drawings of the specification offer no hint of such an arrangement, but do show in fig. 17 a method of getting rid of the evil of a pulsating current for energising the field coils by putting the several armature currents in series, whereby thus combined the resultant current is more nearly uniform in character than the current from either commutator alone. Lines 44, 45, 46, 47, 48 and 49, referred to in the question which describes the operation of the two circuits are perhaps more in sympathy with my last theory than with any of the others.

Looking at page 8, line 38, is it the fact that in compound winding, as claimed by Haddan, that part of the electricity is diverted to maintain the magnetism, while the remaining portion is used to produce the electric light?—No; the whole of the current produced is used to maintain the magnetism of the field magnets.

Is it not the fact that in compound winding the whole of the current produced by the machine circulates round the magnets?—It is.

Is it not the fact that at the date of Varley's patent there were several well-known ways of diverting a portion of a current for one purpose and at the same time using the remainder of the current for another purpose?—There were. So far as I now recollect, the methods of diverting a part of a dynamo current to excite the field, were those of Ladd and Wilde, by the employment of separate armatures; also by Wilde's method of employing some of his armature bobbins to excite the field, and Ruhmkorff's double wound armature. Clark also, in his English patent, No. 4,311 of 1875, indicates a form of "simple shunt" dynamo which also fulfils the terms of the question. In all of these cases that portion of the current not used to excite the field magnets could be used, and was intended to be used, for other purposes.

Is it not the fact that even at the present time there is only one known method of compounding a machine?—That is a fact. I consider the so-called "long shunt" and "short shunt" as being but slightly different modifications of each other.

Do you find any indications in the drawings of the way in which the wire of greater resistance is to be connected?—I assume that this question refers to the drawings of the Varley patent, and with that understanding must answer in the negative. I find only one wire, and that in series with the armature, and arranged to carry the whole current of the machine. This is presumably the wire of lower resistance alluded to in the specification, and on this hypothesis the "wire of higher resistance" does not appear in the drawings at all.

Having regard to pp. C. 22, D. 23, do you find that the wire of greater resistance is intended to do work outside the machines?—Examining that part of the Varley patent to which I understand your question refers I find it to be as follows: "The insulated wire composing the helices is connected to the insulating wire surrounding the soft iron magnets of the machine, and is usually inserted in the circuit of greater resistance." I find that the helices alluded to in the earlier part of the quotation which I have made refers clearly to a part of Varley's electric lamp which he describes to operate with his machine. This lamp contains an electric motor as a part of its mechanism, and the "helices" alluded to formed part of this lamp's motor. Of course the lamp is external to the machine, and is placed in its working circuit. Varley instructs that the "insulating wire composing the helices (of his lamp's motor) is connected to the insulating wire surrounding the soft iron magnets of the machine (the field magnets of the dynamo), and is usually inserted in the circuit of greater resistance." From this it seems, if Varley's "wire of greater resistance" is intended to do work outside of the machine, this work consisting in operating the electromotor of the lamp's mechanism.

Is that consistent with compound-winding?—It might be if Varley's five wire circuit, external to the machine, was kept constantly closed and of constant resistance, and his lamp motor worked with a constant load. The language of the Varley patent referred to in the question seems to me more consistent with some arrangement of circuits other than "compound-winding." Varley adds, alluding to his lamp motor, page 9, lines 24, 29, that "there are commutators which close and open the electric circuit through the helices in succession," &c. This would seem to indicate that Varley alternatively opened and closed the circuit of high resistance in his machine. This would not be consistent with compound-winding in its results.

Is it not the fact that Varley cuts his bobbins out of the circuit for a considerable time, at a time when they are accruing or losing a very considerable amount of magnetism?—Such appears to be the fact.

What is the effect of so doing?—The effect would be to produce violent sparking at the commutators, and would, in my opinion, be quite fatal to any practicability which the machine might otherwise have, if any. Varley's improvement as set forth in his statement of his invention, and described in other parts of his specification, appears to have been founded upon a misconception of the principles involved in the generation of currents in dynamo electric machines; and I do not see how, under any circumstances, his apparatus, as it is described in the specification, so far as it is intelligible, and shown in the drawings, could have been in any sense a practical or useful one.

Would not the bobbins at the time be capable of generating a considerable amount of electricity?—Understanding your question to refer to the conditions specified in your question as to the cutting of the bobbins out of circuit, my answer is, "Yes."

Is Varley's description of the supposed action of his machine a correct one? If not, state in what particulars you consider it incorrect, and your reasons?—As I have already stated, Varley's description both of the construction and operation of his dynamo is exceedingly vague, confused and indefinite. So far as this Varley patent can be approximately understood, it does not give a correct description of the action of a successfully operative dynamo. I have already given some of my reasons, and need not state them again.

Do you find many ambiguities in Varley's specification?—Yes, many. Some of them I have already discussed. I consider this patent of Varley's, taken as a whole, to be ambiguous, incomplete, and uncertain as to be impossible of any satisfactory or consistent explanation on expounding.

Do you consider Varley's machine an improvement of any value upon any form of dynamo known to you, and in existence at the time of his patent?—I have no knowledge of Varley's invention, excepting such as I can gather from his patent, and from this I must answer your question in the negative.

Have you ever heard of one being made?—None other than one I am informed was made many years ago by or for Mr. Varley. But I have never seen it.

Is there anything to show that Varley's two wires were intended to act simultaneously, and to augment each other's effects on the magnets?—There is nothing of this nature disclosed by Varley, so far as I can understand his patent.

Look at Varley, page 6, line 46, to page 7, line 4, and page 7, line 20, to line 50, and page 11, line 42, and page 12, line 5, and the whole of the first claim and the figures referred to. Is the description there given a correct or intelligible description of the way in which electricity is developed in any armature, whether of a compound-wound machine or otherwise?—No.

Would a competent workman reading Varley's specification at the date of Haddan's patent have found directions therein sufficient to enable him to make the invention claimed in Haddan's claim 7?—I think not.

Explain what you understand to have been the invention or arrangement intended to be set forth by Varley?—It seems to me that the idea which Varley intended as the essence of his invention, and sought to patent, is that erroneous one indicated by the portions of his specification referred to already. All the details of his dynamo, so far as I can understand them, appear to be incidental to this idea.

Is the specification or the machine there described of any utility?—Understanding this question to refer to the Varley machine and specification of English patent, No. 4,905, of 1876, I must reply that the machine there described, so far as it is intelligible, would be of no practical utility without material variation and modification from the continuation and the mode of operation, as proposed by Mr. Varley.

In which sheet of your specifications are the commutators described with the third division of Haddan's specification, No. 2,003 of 1878 shown?—In sheet 3.

For how many bobbins is the commutator there shown designed for?—Eight.

(*To be continued.*)

THE ELECTRIC LIGHT AT BARNET.

(*From the "Barnet Press."*)

AT a meeting of the Barnet Local Board, held on Tuesday, February 19th, the contractor, replying to inquiries as to the cause of the light failing, wrote explaining that on one occasion "a hole broke loose in the smoke box," and at another time the pump plunger failed, as also did a "reserve arrangement."

The report of the expert employed to test the light, was as follows:—

"General Post Office, London, 11th February, 1889.

"Dear Sir,—In accordance with the request contained in your letter of January 23rd, and with the resolution of the Board passed on the 15th January, I have pleasure in informing you that I visited Barnet on the 28th ult., in company with Mr. Joel, and inspected the whole of his arrangements there. My assistant, Mr. Probert, an expert in light measurements, visited the locality on the 2nd and 4th inst., and I attach his report to me on the result of his photometric measurements. In answer to the several questions that you have asked me:—1 Q.: 'Are all the 71 lights of 32 C.P. each; if not, of what power are they?'—A. It will be seen from Mr. Probert's report that the lamps are not all of the candle-power specified. 2 Q. 'Is the machinery now employed capable of supplying the 71 lamps with 32-C.P. light?—A. The machinery now employed is capable of supplying 71 lamps with 32-C.P. light. 3 Q. 'Can you give us any data whereby in the future we may determine for ourselves whether we are getting the amount of light stipulated for in the contract?'—A. It would be difficult to measure the light except by photometric means, which require the services of an expert, but which are not difficult to master. 4 Q. 'Are all the lamps of uniform power?'—A. The lamps are not by any means of uniform power. 5 Q. 'Would the present machinery be capable of working another 12 or 15 lights?'—A. The present machinery might be capable of working another 12 or 15 lights, but it would be most impolitic to add more lights without additional apparatus to provide against the possibility of a breakdown. I consider that it is a great risk to continue the lighting of your roads and streets with the existing apparatus. The whole of the apparatus in the central station worked by the contractor should be duplicated. I am sorry to see that such an interesting experiment as the illumination of your parish has been jeopardised by insufficient means to maintain the light uniform and steady.'

"I am, dear Sir, yours faithfully,

"W. H. PREECE.

"W. H. Mansbridge, Esq."

"In submitting the results of my photometric measurements of the electric lamps in the streets of Barnet, I beg to add that during the two evenings of February 2nd and 4th, the lights were, in my opinion, all that could be desired. There is, however, a marked variation in the strength of light given out by the lamps tested. This may be due to absorption of light by the thick glass globe which encloses the electric lamp; to atmospheric absorption; to dirt or grease on the globe obscuring a large proportion of the luminous rays, and to the lamp filaments having deteriorated through use. For absorption, &c., I think the measurements might justly be increased 20 per cent. at least, to represent the actual candle-power of the lamps, and I have therefore in the annexed table furnished a column which shows the results of 20 per cent. augmentation. With this addition, the average candle-power of the lamps numbered 1, 10, 22, 33, 37, 42, 44, 48, 53, and 58 is 27¼. The mean candle-power for the electric lamps, as measured photometrically, is 22·1. The gas lamp was found to equal 12·48 standard candles, hence the average illuminating power of the former shows a percentage increase of 40·6 as compared with the latter."

Appended to the report was a table indicating the lamps tested and their power. The figures placed between parentheses represent the addition of 20 per cent. allowance for absorption. The contract power of the lights is 32 C.P.:—Hadley Green, 21·423 candle-power (25·70); High Street, tenth lamp from Hadley Green, 36·378 (43·65); *junction of High Street and Wood Street, 105·67 (126·82); Park Road, 14·45 (17·34); High Street, first lamp from station, 100· (120·); Manor Road, 15·34 (18·34); Black Horse, 25·837 (31·); Bells Hill, 22·70 (27·24); Wood Street, (top of), 14·65 (17·58); Union Street (second lamp from High Street), 22·457 (27·); The Avenue (third lamp from Black Horse), 34·269 (41·123); Salisbury Road, 19·563 (23·475). *Gas lamp* at top of Barnet Hill (should be 16 C.P.) 12·48 (14·98).

A long discussion followed the reading of the report.

The Chairman said the engineer showed him lamps of different powers at the works; if one lamp was too small a larger one could be put on in a few minutes.

Mr. James: Then there is no excuse for the contractor.

The Chairman: I don't think there is.

Mr. Schmidt: They may be all right when put on, but you cannot get perfect uniformity; the carbon filaments may show defects.

The Chairman: They ought not to do that in so short a time.

Mr. Schmidt: All electric lamps are experimental, but there is now a new lamp in the market surpassing all others.

Mr. James observed that the difference between the gas and electric lamps should be 100 per cent., but the report showed the average of the electric lamps was only 40 per cent. better than the gas, and even this percentage was obtained by including a 100 C.P. lamp which had since been replaced by an ordinary lamp.

Mr. Pooley said the lamps taken showed a higher average than would have resulted if more of the outlying lamps had been included in the test.

Mr. James said the contract was for lamps of 32 C.P., and it was obvious the contractor had not fulfilled his contract. The report showed what the board had long known, namely, that the whole thing was unsatisfactory. Mr. Joel had promised amendment time after time, but there had been no improvement, and the board ought now to protect the ratepayers by calling upon the contractor to fulfil his contract or determine it. He (Mr. James) made a report on the lighting during January, and he now had a report for February, as follows, and for the accuracy of which he was responsible:—

"February 2nd, lights very poor over whole of district; 4th, ditto; 5th, very bad up to seven o'clock, better after; 6th, very poor, lights all out 7.10 until 10.15, then very poor, all out at 12.20, no oil lamps up at 12.45; 7th, Wood Street junction lamp out from 6.50 until 8.20; 8th, all lit, better generally; 9th, lamp by Vicarage out until 7.30; 10th, junction lamp out at 10.40, not relit; 11th, junction lamp not lit until 6.45, all out from 10 to 10.7; 12th, all lights very bad until 7.20, improved; 13th, lamp at Black Horse out at 10.30, not relit; 14th, poor lights, all out 6.30 to 6.37, one in Salisbury Road not relit, junction lamp out from 11 till 12.20; 15th, all very bad, out from 6.30 until 7.20, better until nine, again bad, junction out all night, no oil lamps at 12.40; 17th, all out 8.58 to 9.10, after poor light, all out at 12.25. The above observations are not to be taken as representing the whole of the failures that have occurred, as it is quite possible other lamps have failed at different times without my being on the spot to notice them. There have also been times when the light has been very poor which I have not noted here, my object being to call the attention of the board to the worst cases of failure only." This report did not include all the failures; for it was a frequent experience to find a lamp burning on passing down the town and to find it out when returning. On the report of the experts, he thought the Board were bound to act decisively; and he therefore moved that the contractor be given 14 days' notice, under clause 2 of the contract, to remedy defects; and that on failure, the contract be determined by such notice. Mr. James added that the contractor could not complain that he had been harshly dealt with, having had five months in which to give what he contracted to give.

Mr. Walker said Mr. Probert's report on the light on the 2nd and 4th was in direct contradiction to Mr. James's report; the expert said "The lights were all that could be desired."

Mr. James said he had no objection to put his statement of fact against Mr. Probert's, for it was well known that the light varied very much in a short space of time; but there was a grave discrepancy in Mr. Probert's report, for after saying the light on the 4th was all that could be desired, his figures showed that whereas the contractor contracted to give lamps of 32 C.P., some of them were only 14 C.P. Mr. Probert's assertion about the light was flatly contradicted by his own measurements, and the assertion was valueless in the light of known facts.

Mr. Pooley seconded Mr. James's motion, saying the Board had no right to favour Mr. Joel or any other man. In the interests of the ratepayers they should demand what they paid for and keep the contractor to his contract.

The Chairman: I feel very dissatisfied with the way the contractor is treating us. For the past ten days the light has been so uncertain that one could not depend upon it at all, and I cannot ignore Mr. Preece's report as to the risk of continuing without duplicate plant, and his expressions of opinion that Mr. Joel is jeopardising an interesting experiment by failing to provide adequate appliances. He (the Chairman) did not condemn the electric light, but he must condemn the contractor for not doing his duty.

Mr. Cowles said he was not satisfied with the light, but he thought the Board would be getting on to dangerous ground in attempting to determine the contract. He thought the first step should be to call upon the contractor to provide 32 C.P. lamps.

Mr. Samuels agreed with Mr. Cowles, and urged that before taking a drastic step the Board should communicate with Mr. Joel. At present Mr. Joel sheltered himself behind the fact that the aggregate amount of light was equal to the contract power of the lamps. He (Mr. Samuels) was not satisfied with the light now given, but he deprecated extreme measures while it might yet be possible to get the light improved if they went the right way to work.

Mr. Huggins failed to see in Mr. Samuels's remarks any argument against the motion calling upon Mr. Joel to fulfil his contract.

Mr. Samuels said the Board wished to attain a certain end, and in his opinion the motion was calculated to defeat rather than to promote that end.

Mr. Schmidt said the electric light was as yet an experiment, but it was more successful than gas was 20 years ago, and was daily improving. True, it had failed at Leamington, but there they had not such an engineer and electrician as the one at Barnet. To pass the resolution would be an injustice to the contractor, antagonistic to the interests of the town, and useful to nobody. Mr. Joel had ordered duplicate plant, and would probably have had it here but for being worried continually by such proposals as the present. Only the other day he had an offer of £2,000 capital; but the offer was withdrawn when Mr. James's motion was made public. The light was more successful in Barnet than it had been anywhere.

Mr. Pooley said the notice simply asked Mr. Joel to remedy defects.

Mr. Walker observed that some remedy was required for the present state of things; but the remedy was not to be obtained by giving the contractor notice to determine the contract. The average of the twelve lamps tested showed the town was getting something over the contract light, but it was unequally distributed. He would move, as an amendment, "That the contractor be called upon to provide uniform lights of 32 C.P."

Mr. James said it was the unanimous feeling of the Board that the contractor had failed to fulfil his contract, and the report showed that he was not in a position to do what he had contracted to do, because he could not supply further lights without risk to the whole. After five months of promises the Board were still where they started, and it was a waste of time to delay decisive action. All he asked was that the contract should be fulfilled and that the town should have what it paid for.

The Chairman suggested that Mr. Walker should name some time in his amendment, and he put in "fourteen days."

Mr. Huggins: What is the alternative if he does not do this?

Mr. Samuels replied that it would be time enough to discuss that when they saw the result of the notice which Mr. Walker had suggested. He thought instead of looking only at the faults in electric lighting, they should see what was good in it and get defects remedied. The aim of the Board should be to get the contract carried out rather than to terminate the contract. At present it looked as though the contract would terminate itself without any action on the part of the Board, because a provisional order must be obtained by the contractor from the Board of Trade before he could proceed much further.

Mr. Samuels then seconded the amendment, which was put to the vote and carried, the voting being—For: Messrs. Schmidt, Cowles, Walker, Fisher and Samuels. Against: Messrs. James, Pooley, Huggins and Toone. The chairman and Mr. Emm did not vote.

THE ELECTRIC LIGHTING EXPERIMENT AT BARNET.

A Record of Failures of the Lighting.

(*From the "Barnet Press."*)

The above heading and the article which follows this paragraph are cut from the *Journal of Gas Lighting* for February 19th. We give the whole without comment, beyond saying we regret that the Electrical Review (quoted by the *Journal of Gas Lighting*) should suggest that the expert employed by the Board "informed the contractor when his measurements were to be taken." We think the expert should have made his measurements as privately as possible, and before he put himself into communication with the contractor for the purpose of examining the plant at the central station. After the expert visited the works the contractor —who is always well informed of the intentions of the Local

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* This was a Sunbeam lamp, put up for exhibition; it has since been removed and replaced by an ordinary lamp.

Board—would be on the *qui vive* to keep the lights at their best until the measurements had been taken. Possibly the contractor knew when the measuring was going on—others saw the expert at work in the streets if the contractor did not—but we repudiate entirely the suggestion made by the ELECTRICAL REVIEW that the expert betrayed the confidence of the Board. Here are the articles to which we have referred :—

Our readers have doubtless followed with much interest the accounts we have given from time to time of the experiment in electric lighting which has been going on for nearly six months at High Barnet. The installation commenced on the 1st of September last year with 71 incandescent lamps ; and, although the local authority was lauded by the majority of the Press for their public-spirited enterprise in adopting the new light, its advent in Barnet was not unattended with a certain amount of discomfort, not to say pain, to the projectors of the scheme. From the first it has been a weakly bantling ; and its struggles for life would be amusing, were it not for the annoyances, and even dangers it has needlessly entailed on the unfortunate inhabitants. The brief reports which have from time to time appeared in our columns of what has taken place at the meetings of the Local Board, have been sufficient to show how unreliable the lighting has been all through, and in our last issue we had to record the fifth total failure. But in order that our readers may be in a position to judge for themselves in the matter, we give below a list of the days on which particular lamps, and sometimes the whole installation, have been out.

Date.	Lamps out.	Date.	Lamps out.	Date.	Lamps out.	Date.	Lamps out.
Sept. 1	24	Oct. 1	2	Oct. 29	2	Nov. 28	2
„ 2	26	„ 2	2	„ 30	1	„ 29	2
„ 3	25	„ 3	7 *d*	„ 31	2	Dec. 1	1 *l*
„ 4	23	„ 4	8	Nov. 1	5	„ 2	1
„ 5	25	„ 5	6	„ 2	4 *g*	„ 8	1 *m*
„ 6	25 *a*	„ 6	2	„ 3	2	„ 9	1 *n*
„ 7	24	„ 7	3	„ 4	2 *h*	„ 10	1
„ 8	23	„ 8	4	„ 5	1	„ 15	1
„ 9	24	„ 9	3	„ 6	1	„ 16	1
„ 10	21	„ 10	2	„ 7	1	„ 23	1
„ 11	18	„ 11	4	„ 8	1	„ 29	1
„ 12	20 *b*	„ 12	7	„ 9	1	„ 31	1
„ 13	19	„ 13	4	„ 11	*i*	Jan. 5	1
„ 14	8	„ 14	4	„ 12	1	„ 6	1
„ 15	8	„ 15	5	„ 13	3 *j*	„ 7	1
„ 16	7	„ 16	4	„ 14	3	„ 11	*o*
„ 17	9	„ 17	6	„ 15	3	„ 13	1
„ 18	2	„ 18	2	„ 16	3	„ 14	1
„ 19	3	„ 19	3	„ 17	2	„ 23	5 *p*
„ 22	3	„ 20	4	„ 19	1	„ 24	3
„ 23	2	„ 21	4	„ 20	1	„ 26	2
„ 24	3	„ 22	2	„ 21	3	„ 27	2
„ 25	4	„ 23	1 *e*	„ 22	4	„ 28	*q*
„ 26	3	„ 24	2	„ 23	1	Feb. 6	*r*
„ 27	5	„ 25	1	„ 24	1	„ 7	1
„ 28	3 *c*	„ 26	1	„ 25	1	„ 9	1
„ 29	3	„ 27	1	„ 26	1 *k*	„ 10	1
„ 30	3	„ 28	1 *f*	„ 27	1	„ 11	1 *s*

Remarks.

a. September 6th.—All lamps went out at 10.15 p.m. for some minutes.
b. „ 12th.—The lamps were lit this night at 7.15 p.m. ; at 7.45 all went out. They were relit ; but again went out at 8.25 pm., and were not relit.
c. „ 28th.—All lamps went out at 9.55 p.m., and remained so.
d. October 3rd.—Lamps not lit till 6.45 p.m.
e. „ 23rd.—All lamps went out from 9.25 to 9.50 p.m.
f. „ 28th.—All lamps nearly out at 6.25 p.m.
g. November 2nd.—All lamps out from 5.40 to 5.50 p.m.
h. „ 4th.—All lamps out from 5.25 to 5.40 p.m.
i. „ 11th.—All lamps out from 7.25 to 7.43 p.m.
j. „ 13th.—All lamps out from 6.45 to 7.15 p.m.
k. „ 26th.—All lamps out from 6.37 to 6.45 p.m.
l. December 1st.—All lamps out from 11.22 to 11.35 p.m.
m. „ 8th.—All lamps out from 6.35 to 9.20 p.m.
n. „ 9th.—All lamps out at 11.45 p.m., and remained so.
1889.
o. January 11th.—Nearly all lamps out from 9.5 to 10.10 p.m.
p. „ 23rd.—All lamps out till 9.5 p.m.
q. „ 28th.—All lamps out from 5.50 to 5.55 p.m.
r. „ 6th.—All lamps out from 7.10 to 10.15 p.m.
s. „ 11th.—All lamps out from 10 to 10.7 p.m.

Not only do the lights totally disappear for minutes and hours together, from a multiplicity of mysterious mishaps—including alleged cutting of wires and breakage of poles carrying the wires, failure of machinery, &c.—but they vary continually ; the light at times being brilliant, and raising the drooping spirits of its partisans, at others so dull as only to render darkness visible by glowing bits of wire. No wonder, then, that the Local Board are exercised as to whether they are receiving what they pay for—viz., 32 candle-power lamps—and have appointed an expert to advise them (at, of course, more expense). Add to these incidents the danger of overhead wires and the extra cost, and the inhabitants may well wish for an early deliverance from the so-called "light of the future."

PROCEEDINGS OF SOCIETIES.

The Institution of Civil Engineers.

THE thirteenth ordinary meeting of the session 1888—89 was held on Tuesday, the 19th of February, under the presidency of Sir GEORGE B. BRUCE. The paper read was on "Alternate Current Machinery," by Mr. GISBERT KAPP, Assoc. M. Inst. C.E.

The theory of alternate current machines, as given in modern text-books, was based upon the assumption that the currents were generated in wire coils, the magnetic induction through which underwent periodical changes according to a simple sine function. A machine of this character would be represented, in its most elementary form, by a coil of insulated wire revolving round an axis in its own plane, with uniform velocity in a uniform magnetic field, the axis of rotation being at right angles to the lines of the field. The electromotive force at any moment was

$$e = 2 \pi n s \frac{r}{2} \sin \alpha,$$

where n was the frequency (number of complete periods per second), r was the number of wires in both branches, A and B, of the coil collectively, s was the total induction through the coil when the latter stood at right angles to the lines of force, and α was the angle between this position and the position at which the electromotive force, e, was generated. The mean electromotive force was

$$e = \frac{\pi}{\sqrt{2}} n s r.$$

It was convenient to compare this value with that representing the electromotive force of a direct current machine having the same field and external number of wires, r (but equally distributed), on the armature. The electromotive force of such a machine was given by the product $s\, r\, \frac{N}{60}$, where N, the number of revolutions per minute, might obviously be replaced by $60\, n$ when the machine had two poles ; because in this case, frequency and number of revolutions per second were identical. The ratio between the electromotive forces of the two machines remained the same, namely, $\frac{\pi}{\sqrt{2}}$. Alternators as now constructed had more than one pair of poles, which were set in a circle, and were so arranged that the coils of the armature swept past them. As the interpolar space was always very small, the density of lines, emerging from or entering the polar surfaces, might be taken as fairly uniform over the extent of these surfaces, and it became thus possible to determine for every shape of coil, the configuration of polar surface which would produce that variation in the induction which corresponded to the simple sine function. Poles of this shape were, however, not used in practice ; the poles were either trapezoidal, circular, or rectangular. In the Mordey alternator the poles had a trapezoidal face, and those succeeding each other on the same side of the armature were of the same sign, and were placed in line with those of opposite sign on the other side of the armature. Thus along the mean pitch-line uniform fields alternated with spaces, in which there was no induction. The electromotive force of this arrangement was

$$e = 2 n s r.$$

The type of field most commonly used in modern alternators was, however, one in which N and S poles succeeded each other around the armature, and the portion of the armature not embraced by the poles might be taken as equal to that embraced. The electromotive force of this arrangement was

$$e = \frac{4}{\sqrt{2}} n s r,$$

These results referred to machines in which the active wires on the armature were concentrated into single lines. This was of course impossible in practice ; the wire coils on the armature, whether this contained iron or not, must occupy a considerable space, and this circumstance would, generally speaking, cause the electromotive force obtainable, with the different forms of fields considered, to be lower than the values given. The reason for this reduction was that with a wide coil all the turns were not equally and simultaneously influenced by the field, and in certain positions the action was differential. The calculation of the effective mean electromotive for any configuration of field and armature coils presented no special difficulty, though for certain complicated forms the operation was somewhat laborious.

The electromotive force of an alternator could be expressed as the product of the electromotive force of a direct current machine, having the same dimensions and weight, and a certain coefficient depending on the configuration of the field magnets and armature coils. The winding and other constructive data of an alternator being known, it was only necessary to find this coefficient in order to determine the electromotive force, by reference to the electromotive force which would be produced by the same machine if the armature coils were connected in such a way as to give a continuous current. The electromotive force in volts of an ordinary dynamo was given by the formula :

$$e = s\, r\, N\, 10^{-8},$$

where s represented the total induction in English lines of force (each equal to 6,000 C.G.S. lines), r the total number of active wires counted all round the armature, and N the speed in revolutions per minute. If the machine was multipolar, and if the different armature circuits were arranged in series, the expression for e must be multiplied by p, the number of pairs of poles in the field. Let k be the coefficient which expressed the ratio between the electromotive forces of the alternate and continuous current machines, then the formula for the former was

$$e = k\,p\,s\,\tau\,N\,10^{-8}.$$

The following table gave the value for k for different cases, all referring to poles of rectangular shape and coils in which the active wires were straight :—

1. Width of poles equal to pitch, toothed armature and winding concentrated in the recesses ...	$k = 2{\cdot}000$
2. Width of poles equal to pitch, smooth armature and winding spread over the whole surface ...	$k = 1{\cdot}160$
3. Width of poles equal to pitch, smooth armature and winding covering only one-half the surface	$k = 1{\cdot}635$
4. Width of poles equal to one-half the pitch, smooth armature and winding spread over the whole surface	$k = 1{\cdot}635$
5. Width of poles equal to half the pitch, smooth armature and winding covering only one-half the surface	$k = 2{\cdot}300$
6. Width of poles equal to one-third the pitch, smooth armature and winding covering only one-third of the surface	$k = 2{\cdot}830$

According to the ordinary sine formula the coefficient was $k = 2{\cdot}220$; and this agreed fairly well with case 5, which was most frequently met with in practice. The formula for e pre-supposed the knowledge of the total induction s, which depended upon the shape and size of the field magnets, their arrangement, the amount of iron in the armature, the interpolar space, and the exciting power. This subject has been very fully treated by Drs. J. and E. Hopkinson, and the author had also dealt with it. These methods had subsequently been improved by the introduction of certain terms due to Prof. Forbes, by means of which the magnetic leakage could be more accurately ascertained. With the knowledge of the total induction, s, and the coefficient, k, it was thus possible to determine the relation between exciting power and electromotive force of any given alternator. The effect of self-induction was to produce an electromotive force, the phase of which was at right angles to that of the current; and the electromotive force available for doing work in the circuit was the resultant of the induced electromotive force and that due to self-induction. The author then described some graphic methods by which the problem could be treated in a simple and easily understood manner.

In alternators used for parallel distribution the object aimed at was generally to keep the terminal pressure constant for all currents, and this could be attained by working with a constant field and suitably varying the speed, or by maintaining a constant speed and adjusting the exciting current so as to suitably vary the electromotive force. The latter plan must be adopted if several machines were worked in parallel; and in this case the graphic method might be used to determine the limits between which the exciting current must be varied to keep the terminal electromotive force constant for all loads, from no current to the greatest current the armature was intended to pass. The mean induced electromotive force, e, was found by the above formula, and its maximum value was obviously

$$E_t = \sqrt{2}\,e.$$

The maximum value of the electromotive force of self-induction was given by

$$E_s = 2\,\pi\,n\,L\,I,$$

where L was the coefficient of self-induction, which could be determined by various well-known methods; or by running the armature in a constant field, and measuring the terminal electromotive force with and without a current passing through the armature. The electromotive force lost in resistance was simply the product of the current, I, and the resistance, R, of the armature. With the knowledge of these quantities it was easy to determine the strength of field required for any current.

The problem of parallel working was of the greatest importance for central stations, as only by such an arrangement of machines was it possible to ensure absolute continuity of the service and the greatest economy at all times. Alternate current distribution should, if possible, be carried on in the same simple manner as direct current distribution—that was to say, the number of machines at work should correspond as nearly as possible to the output at any time; the addition or withdrawal of machines should not even momentarily interrupt the supply of current to any part of the system of distribution. These conditions, it would easily be seen, could only be fulfilled if the machines were capable of working in parallel, and the problem might be stated somewhat in this fashion: Given an alternator, with excited field and running at a proper speed, and a pair of terminals from which any desired strength of current could be obtained at a constant pressure, and having a frequency approximately corresponding to the speed of the alternator, what would be the condition under which the alternator would fall into step with the supply current, and what would be the relation between the current passing and the mechanical energy given off? Also, how would this relation be affected by variations in the strength of the field? This problem was also treated by graphic methods, and it was found that the only and sufficient condition for successful parallel working was a sensible amount of self-induction in the armature circuit. It was well known that alternators having no iron in their armatures could not be run in parallel, except by the adoption of some such expedient as choking coils; also that parallel running was feasible with those alternators which had iron cored armatures. If a machine were run at constant speed on open circuit, and with different strengths of exciting current, different terminal electromotive forces were obtained. A characteristic could then be plotted, the abscissæ of which represented exciting power, whilst the ordinates represented terminal electromotive force, which in this case was the same as the induced electromotive force. Having obtained this curve, which the author suggested should be called the "static characteristic," the dynamic characteristic of the machine was determined for a certain current through the armature by so adjusting the resistance in the external circuit that for all exciting powers the current remained the same. The curve so obtained must obviously lie wholly under the first curve, and the difference between the ordinates of the two curves depended upon the choice of current for which the second test had been made, and upon armature resistance and self-induction. Besides these two curves there was a third—namely, that obtained when the machine was driven as a motor running light. To find this curve it would be necessary to have at disposal at least two similar machines, using the one as generator and the other as motor, and during the test the field strength of both machines would have to be regulated, so as to keep the current at its predetermined value. Thus, a "motor characteristic" would be obtained, lying wholly above the "static characteristic." As the last experiment was, however, only possible if two machines could be tested at the same time, and was also somewhat delicate, another method of investigation was desirable. This could be done by using one of the author's diagrams to deduct the motor characteristic from the two other curves, the experimental determination of which presented no difficulties whatever, and would, indeed, be made as a matter of course in the ordinary test of the machine before it was sent out from the manufacturer's. Diagrams were shown which contained these various curves as determined for one of the author's machines, constructed for an output of 60 kilowatts.

In any dynamo machine there were two causes for heating, in addition to purely mechanical friction. These were the resistance of the conductors, and the change of magnetisation of the iron parts of the machine. As regarded the first cause, the liability to the generations of eddy currents in the armature conductor was much greater with alternators than with continuous current dynamos, and in alternators it varied with the construction of the armature to a greater degree. When the armature contained no iron, the heating from eddy currents was much greater than when such a core was used, and the armature conductors must therefore be made in the form of a very narrow strip. The other cause of the generation of heat, the change of magnetisation in the iron parts, could be minimised by lamination, but never entirely avoided. In direct current machines the heating from this cause was, however, generally so small that no account was taken of it, except when the induction in the armature core was pushed beyond 18,000 or 20,000. In alternators a much lower induction produced sensible heating, and it was for this reason that the maximum induction must be fixed at a very low figure. With a perfectly laminated core, the heating was attributed to an effect which Prof. J. A. Ewing called "hysterësis," and which might be described as molecular friction. This scientist had experimentally determined the energy required to carry certain samples of iron through a complete cycle of magnetisation of varying degree, and the results had been published in the "Philosophical Transactions." They were given in ergs per cubic centimetre; but as these units were rather inconvenient for application in the workshop or drawing office, the author had in the following table, which referred to annealed wrought iron, translated them into watts per ton and H.P. per ton.

Induction.		Watts per ton. $n = 100$.		H.P. wasted in heat.
2,000	...	650	...	0·87
3,000	...	1,100	...	1·48
4,000	...	1,650	...	2·21
5,000	...	2,250	...	3 02
6,000	...	2,900	...	3·89
7,000	...	3,750	...	5·03
8,000	...	4,450	...	5·97
9,000	...	5,550	...	7·43
10,000	...	6,650	...	8·90

Modern transformers were provided with a core of laminated iron, which was symmetrically placed in respect to the two windings, so that the same induction passed through both the primary and the secondary coils. Under these conditions, the electromotive force induced in the two circuits was simply proportional to the number of convolutions they respectively contained, and the terminal electromotive forces were found by adding in the case of the primary, and subtracting in the case of the secondary, the loss of pressure due to the resistance of the coils. In a properly designed transformer, this loss of pressure should not exceed about 1 per cent. of the terminal pressure, so that the maximum difference in the pressure maintained in the secondary circuit between the lamps, when the apparatus was used for parallel distribution, did not exceed 2 per cent. between full and no load provided the pressure in the primary circuit was kept constant. Such a small variation in the pressure was well within the limits attainable in direct lighting, when a compound wound dynamo was driven from an engine with a fairly good governor, and the corresponding variation in the illuminating power of the lamps was sufficiently small to be tolerated. A greater variation, especially if it occurred suddenly, would, however, not be permissible; and the question, therefore, arose as to what rules should be followed in designing transformers so that they might as nearly as possible be self-regulating. The obvious answer was, make the resistance of the circuits as small as possible, and this might be accomplished in three ways: 1. By using wire of large area. This expedient naturally increased the weight, bulk, and cost of the transformer, and must, on account of commercial reasons, not be pushed too far. 2. By employing a core approximating to a circular or quadratic section, so as to decrease the perimeter of the coils. 3. By working with a high induction, or with a high frequency.

The mean electromotive force in volts, induced in the coil of a transformer, could be expressed by the following formula:—

$$e = (q)\,2\,\pi\,n\,s\,r\,10^{-8},$$

in which (q) was a coefficient denoting the ratio between the maximum and the mean electromotive force, n was the frequency, s the total induction in absolute units, and r the number of turns contained in the coil. The larger s, and the smaller n, might be the length of wire, and therefore its resistance. On purely theoretical grounds it would thus seem that a small core strongly magnetised, and as high a frequency as the alternator could be constructed to give, would produce the best results. In practice, however, this conclusion was wrong, and the heating of the iron core in consequence of hysteresis must be taken into consideration. Since a transformer was an apparatus at rest, and was frequently placed in a position where the cooling effect of the air was small, the ratio between heat generated and available cooling surface must be very different from that permissible in a dynamo, and it was this ratio which was the true limit to the output of a transformer. The armature of a dynamo was not subjected to excessive heating if a cooling surface of about 1 square inch per watt was provided. In a transformer, the amount of cooling surface should be at least three times, and if possible, four or five times as great, especially as it was somewhat difficult to determine, in a body of such complicated shape, what was and what was not effective cooling surface. From the above table it was easy to calculate for any induction, frequency and weight of the active iron in a transformer, what the heat of the iron would be; and, adding to this the heat of the copper, the total cooling surface required to keep the apparatus at a safe temperature could at least approximately be determined, or the limit of output for any given transformer could be approximately found.

The question of frequency, alluded to in connection with alternators, was also of considerable practical importance with regard to the transformers, and it was much to be desired that electrical engineers should adopt a common standard. The following was a list giving the average frequencies adopted by several designers: Ferranti, 67; Lowrie-Parker, 88; Mordey, 100; Zipernowsky, 42; Kennedy, 60; Kapp, 80; Westinghouse, 133. Taking the average of European practice, the frequency was 73, or 8,750 reversals per minute; whilst the American practice was 16,000 reversals per minute. This large difference might, to a certain extent, be accounted for by the general preference of European engineers for machines running at moderate speeds; but even when making due allowance for this circumstance, it could hardly be assumed that, had actual practice shown the value of a very high frequency, electrical engineers would not have found means to obtain it. As a matter of fact, most makers of alternators had started with a much higher frequency than they had finally adopted. It should also be remembered that the higher the frequency, the greater was the loss of conductivity in the mains, owing to the unequal distribution of current throughout their cross-section.

The author then discussed the questions of alternate current motors on the Ferraris principle, and next passed on to a description of the different modern alternate current machines most in use. Constructive data were given for the Ferranti, Mordey, Kennedy, Kapp, Lowrie-Hall, Westinghouse, and Zipernowsky machines; and in most cases the actual performance of the machine was compared with the calculated electromotive force, so as to show within what limits the author's formulas for alternators of different types were in accord with experimental results.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1888.

1213. "Improvements in the application of electricity to spectacle frames." J. T. LEIGHTON. Dated January 26. 8d. Claim:—In the application of electricity to spectacles and eyeglasses, the adaptation to the frames thereof of voltaic piles, substantially in the manner and for the purposes described and set forth.

1875. "Improvements in dynamo-electric machines and in electro-motors." G. HOOKHAM and R. H. HOUSMAN. Dated February 8. 8d. Claim:—In a dynamo or motor the use of a subsidiary magnet or subsidiary magnets, wound with coils carrying the main current, or of a subsidiary magnet or subsidiary magnets in conjunction with compound-winding, on one side limb of the main magnet, the strength of the said subsidiary magnet or subsidiary magnets being so proportional, and adjusted to that of the principal magnet, as to keep the lead of the brushes constant, and thereby to regulate the electromotive force of the machine with varying currents, substantially as described and illustrated in the drawings.

1891. "A flexible battery cell and method of arranging the elements therefor." M. BAILEY and J. WARNER. Dated February 8. 8d. The inventors construct the walls of the flexible cell of rubber insertion cloth, india rubber, gutta-percha or cloth, or equivalent substance prepared with varnish or other suitable material for rendering the same watertight, and resisting the action of the acid or other liquid employed in the cell. The cells are fitted with elements in the form of leaf metal, coarse granulated powder, or they can be fashioned in the form of a mat or web, from wire, ribbon, or other suitably woven metallic material. These elements, when mounted up in the flexible cell are separated by any suitable porous insulating substance which will not add any great resistance to the free action of the exciting acid or other liquid employed or the flow of current, and will not lessen the flexibility of the cell. The claims are 4 in number.

3312. "An improvement in voltaic batteries." E. TYER. Dated March 3. 8d. The inventor forms at the bottom of the cell an annular trough which he charges with mercury. Into this mercury is immersed the end of the element which, preferably, is in the form of a vertical hollow cylinder or tube of zinc. Over this is placed a bell glass or a bell of ceramic ware, made with a stem projecting upwards through a guide hole provided with a setting screw, so that the bell can be more or less raised and fixed at any desired height. When the bell is down in its lowest position, its edge dipping into the mercury, it prevents access of the exciting liquid to the zinc, but by raising the bell more or less, the liquid is allowed to act on a greater or less extent of the surface of the zinc, according as more or less current is desired. As the zinc is always partly immersed in the mercury, the amalgamation of its surface is constantly maintained. There is 1 claim.

CORRESPONDENCE.

Barnet Lighting.

In pioneering the system of incandescence lamps in series for street lighting at High Barnet, we have had to contend with great opposition and unusual difficulties, but even taking into account the stoppage of the light owing to uncontrollable causes, such as wilful damage to our wires, &c., the whole of the failures during the past six months and severe winter weather, has barely exceeded 1 per cent. of the total hours of lighting, and this, we submit, is very encouraging, and is, we believe, the best record of town lighting.

In the opinion of many qualified engineers who have visited Barnet, the system of street lighting by 32 C.P. incandescence lamps is a success.

HENRY F. JOEL & CO.

February 27th, 1889.

Comparisons.

As a subscriber to both your Journal and the *Electrician* from their commencement to the present time, I may perhaps be allowed to make a few remarks anent your note contained in your issue of February 8th, with reference to the *Electrician* and Submarine Telegraphy.

You ask, "Are not writings, especially those of a scientific character, upon submarine cables and their adjuncts rather conspicuous by their absence in the pages of the magazine established by Sir John Pender," &c.

I have both periodicals complete from No. 1 to the last week's issue, and I think that on careful examination of the volumes of the two serials in question, you will find that the number of papers and items referring to these matters throughout the volumes of the *Electrician* is somewhat in excess of those published by the ELECTRICAL REVIEW during a corresponding period.

There was a time when our branch of electrical science obtained a fair share of the attention of electrical writers. When the *Electrician* was established there was no other journal which devoted its pages to electrical matters in general except your own, which was then the TELEGRAPHIC JOURNAL (in large capitals) and the ELECTRICAL REVIEW (in small do.) Later on our share of the electrical periodical literature of the day gradually dwindled, the Society of Telegraph Engineers has become the Institute of Electricians. Your journal has become the TELEGRAPHIC JOURNAL (in small capitals) and ELECTRICAL REVIEW (in very large ones).

We are selfish enough to regret these changes, but we know that naturally the increase of the circulation must be the first aim of most newspapers, electrical or otherwise, and we understand perfectly that, with the recent great development of electrical science, it is inevitable that we should be, more or less, crowded out. Still, that we find ourselves neglected is not our only cause for complaint. The telegraph mileage, under the direction of Sir John Pender, and the so-called "cable ring," comprises more than two-thirds of the submarine communications of the world, and even the TELEGRAPHIC JOURNAL (in small capitals) might be expected to support the interests of submarine telegraphy rather than those of the telegraphic public who are *not* their subscribers. On the contrary, for a dozen years and more those employed in the Eastern and other submarine companies have not been able to close their eyes to a certain *animus* against their employers manifesting itself in your pages, for which they see no obvious reason, and which is naturally distasteful to them. The so-called cable-ring employs some 800 or 900 men, many of whom have been in that service since the early days of submarine telegraphy. They take a natural pride in the extension to which these great enterprises have attained, an extension due in a great measure to the energy and foresight of this much abused "cable-ring," and in spite of the disparagement of those who should be their friends.

Excuse the length of this protest from one of the many who hold a similar opinion.

Henry N. Blackwood-Price.

Eastern Telegraph Company, Trieste,
February 20*th*, 1889.

[With reference to the above, we would desire to make a slight modification: we would confine the period affected by our comparative allusion of a few weeks ago to recent times. We must congratulate Mr. Price on his nicely worded defence of his chiefs' periodical and for the expression of his own views of our work. It is but natural that he should hold such opinions, and we think such a championship really deserves some special acknowledgment at the hands of his chiefs. The energy and foresight of the cable ring require no laudation from us; but they are undoubtedly possessed in full measure by it. While giving all credit to the "ring" for the possession of these advantageous qualities, we venture to retain our own opinion as to the origin of our contemporary now so artlessly attributed to the desire to "disseminate telegraphic science all over their (the Eastern Telegraph Company's) telegraphic system." The extreme anxiety in this respect of the chief proprietors probably accounts for the super-editorial department being in the neighbourhood of Old Broad Street rather than Fleet Street.—EDS. ELEC. REV.]

The St. Katherine's Lighthouse.

Seeing your articles in the REVIEW with reference to the St. Katherine's (or as the local villagers call it the Niton) Lighthouse, I beg to forward you some particulars of the light during some weeks' residence on the Isle of Wight this winter. I watched the light on several occasions, and I noticed that the light did go out occasionally for two or three seconds, but the lantern being revolving I cannot see that that short space of time would seriously interfere with the efficiency of the light. In a fog the light is of very little use, as there are some dangerous rocks about a mile from the shore, and the light could not be seen in a fog at that distance, but they have a fog siren which can be heard for several miles around. With regard to the electric lamp used, it is a De Meriten's lamp taking two and a half inch carbons corrugated. I was told they used ordinary cored carbons, but they did not work so well as the corrugated. The lamp is a focussing lamp, and during the winter months I was informed that they used the two lamps which are in the lantern alternately.

I observed the light on one foggy evening. Even close to the lighthouse, it looked nothing, and a little distance away was unobservable; but on a fine dark night the effect is very grand, as the light in revolving illumines the surrounding hills and throws its beams on the sea at the same time. There is always a man in the lantern house at night, so that it is well looked after.

J. Jones.

Harrow Lighting.

A report in the *Harrow Gazette* has found its way into the columns of one of the technical journals. Its form would lead a reader to suppose that it was absolutely verbatim, or, at any rate, sufficiently so to accurately represent what passed at the meeting. I find, however, on reading it over that there are important omissions. For instance, after stating that I explained the two well-known methods of distributing electricity by alternating transformers and battery transformers, I am made to say simply that the former system was the best suited for Harrow, whereas I took considerable pains to point out that although, as a rule, I had a preference for the battery transformer system, yet on account of the peculiar distribution of the Harrow lighting in a small number of large houses, distributed over a considerable area, the alternating transformer system was at its very best as regards first cost when compared with the other, but I went on to say that if the other site which had been pointed out at the west end of the town was adopted, the balance would turn the other way.

I wish this to be clearly understood, as since the reading of my paper last year, and the discussion which followed thereon, there has been a disposition on the part of those who did not carefully follow that discussion to consider me as the uncompromising opposer of alternating transformers for any system of electrical distribution, wherever it may be situated.

If those who are interested on the subject will turn to my paper they will see that I then dealt with the unsuitability of the alternating transformer system for central station lighting in densely-populated towns, such as London. I acknowledged from the very first its great utility for lighting suburban districts, towns, or villages where the houses to be lighted are scattered over a considerable area, and where overhead conductors can be wholly or partially used.

R. E. Crompton.

February 25*th*, 1889.

The Telephone in Tunbridge Wells.

Referring to your notice of the meeting held in Tunbridge Wells on the 15th inst., perhaps you will kindly allow me to correct a slight inaccuracy. The report states that Mr. Powell collected the 28 instruments and sent them to the offices of the U.T.C. The following paragraph from the memorial sent to the South of England Telephone Company explains matters:—"And we would further call attention to the fact that immediately Mr. Powell became aware of the injunction being submitted to he not only handed over the telephones he had in stock, but at once collected all he could from his customers and delivered them to the U.T.C., together *with the names of those persons who refused to give them up*. We fail to see what more could be expected from an honourable man of business."

A Subscriber to the Telephone Exchange.

[redacted]